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The University of Minnesota Bulletin

Department of Agriculture

SHORT COURSE IN TRACTION ENGINEERING

May 25th to June 18th, 1909

UNIVERSITY OF ILLINOIS
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PRESIDENT'S OFFICE

A Practical Lesson

Volume XI SEPTEMBER, 1908 Number 2

UNIVERSITY FARM
St. Paul, Minnesota

Entered at the Postoffice in Minneapolis as second-class matter
MINNEAPOLIS, MINN.

THE BOARD OF REGENTS

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The President of the University

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The Hon. PIERCE BUTLER, St. Paul, - - - - - - 1910

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The Hon. W. J. MAYO, Rochester, - - - - - - - 1913

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C. D. DECKER, Austin, Secretary of the Board.

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The course is complete in itself, covering four weeks of study and practice. The mornings are devoted to lectures and class-room work, and the afternoons to actual practice in the various departments under the supervision of the instructors of the school.

Such a course opens a great opportunity to the young man interested in mechanics, or to one who has had some practical experience in the handling of engines, offering in a short time the training in the theory of engineering.

LOCATION AND EQUIPMENT

The short course in traction engineering is held at University Farm, St. Paul, midway between St. Paul and Minneapolis, and is a ten-minute walk from the car line. To reach the farm, take the Como-Harriet or Como-Hopkins car from either city and get off at Commonwealth Avenue.

The entire equipment and the faculty of the Department of Agriculture are at the disposal of this course and provide a splendid oppportunity for pursuing the work.

Located as it is between the two great cities of the Northwest, the students find every advantage at hand to become proficient engineers.

PORTION OF LARGE DINING HALL.

This room will seat at tables about 400 persons at one time. Besides this, two smaller dining rooms are used by students.

EXPENSE OF COURSE

The tuition for the entire course is fifteen dollars, payable as a registration fee at the time of entrance. This covers the instruction in all departments, traction, stationary and gas engines. No deduction is made if the student elects but a part of the course, or fails to complete work from any cause whatever.

Each student is required to furnish work-clothes, overalls and gloves, and be prepared for the expense of car-fare on trips of inspection to visit factories, etc.

ARRANGEMENTS FOR ACCOMMODATION

Good board and room will be furnished on the campus of the school for $3.50 per week. The large dining-hall at the school will be in service, and the dormitory rooms may be used under proper regulations. The rooms have all necessary furniture except pillows, sheets, quilts and towels. These articles may be brought from home by the student, or for a small fee he may rent them for use during the month.

The Campus is as beautiful as a Park in Summer

This arrangement will keep all the students together and will allow more time for the practice work in all departments.

INQUIRIES

Students wishing to register for the course, or desiring further information, should apply to D. D. Mayne, Principal, or Jas. M. Drew, Registrar, University Farm, St. Paul, Minn.

REQUIREMENTS FOR ADMISSION

Any person of good moral character, who can read and write, may be admitted to this school. No entrance examination is required. The work is made so plain and simple that those whose education is limited may pursue the course with profit. Knowledge of physics or of algebra is not necessary. Those who have had these subjects may make good use of their knowledge in the course, but they are not required for admission.

TIME OF SESSION

The Short Course in Traction Engineering opens Tuesday, May 25, and continues for four weeks, closing Friday, June 18,1909. Those desiring to take the course should register and secure boarding places not later than Monday, May 24, as work begins promptly Tuesday morning.

General View of Buildings

Machinery Shed and Experiment Plots

COURSE OF STUDY

TRACTION ENGINES

Steam.—Properties of steam, the steam table, latent heat of vaporization, total heat of vaporization, specific volume of steam, work done by steam, work diagrams, expansion of steam.

Boilers.—Types of boilers: Steam boiler, locomotive boiler, return-flue boiler, the vertical boiler. Construction and repairing of boilers. Boiler materials. Riveted joints, staying flat surfaces, tubes and tube sheets. Boiler fittings: Fusible plugs, grates, safety valve, steam and water gauges, the whistle. Boiler feeders: Pumps, the injector.

Combustion of Fuels.—The process of combustion: Igniting temperature; products of combustion; combustion of carbon complete; combustion of carbon incomplete; combustion of hydrogen; heat of combustion; temperature of combustion; conditions required for economical combustion. Fuels. Firing.

The Traction Steam Engine.—The mechanism of the steam engine. The slide valve and steam distribution: Outside lap, inside lap, angle of advance, effects of lap, lead, position of the eccentric, rocker-arms, direct and indirect valves, setting the slide valve, dead centers, to place the engine on its dead center, directions for setting slide valve. Reversing gears: Single-eccentric reversing gear, the Stephenson link motion. Compound engines: Efficiency of heat engines; absolute zero; absolute temperatures; principles of the compound engine; compound traction engines. Various details of the traction engine: The traction gearing; compensating gear; drive wheels; the governor; cylinder lubricators. Operation and care of the traction engine: General examination; the boiler; feedwater; exhaust nozzles; use of the whistle; the engine; starting the

engine; the engine on the road; guiding the engine; the friction clutch; setting the engine; connecting-rod brasses; tests for leaks; friction and lubrication; winter care of the engine; portable engines.

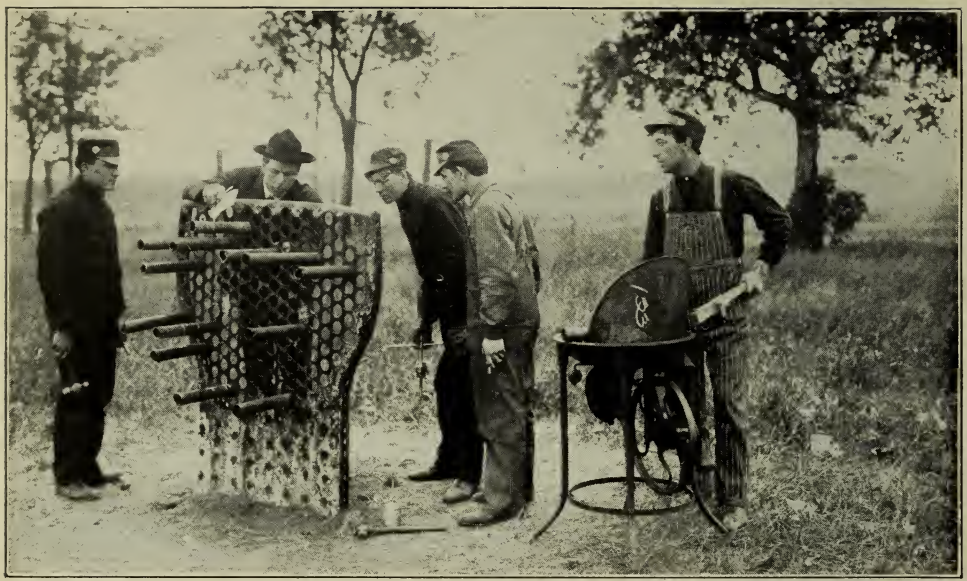
Indicators and Indicator Diagrams.—Description of the indicator. Directions for using the indicator: Reducing motion; directions for taking indicator diagrams; points and lines of the diagram. Horse-power: Mean effective pressure; approximate determination of mean effective pressure; piston speed; friction horse-power; net horse-power; mechanical efficiency. To find the traction force of a traction engine. Reading indicator diagrams. Operation of traction engine: Ascending and descending hills, pulling load in the sand, in mud, over bridges, getting out of a sink hole, etc.

STATIONARY ENGINES

Although the general principles given with reference to traction engines apply with equal force to stationary engines, yet there are some subjects that should be taught with reference to the stationary engine that do not apply to the traction engine. Students who wish to do so may take this work in a special class that will be formed of those interested in stationary engines.

GASOLINE ENGINEERING

Within the past few years the engines using the explosive power of gas as the means of securing mechanical motion have come into very extensive use. Whereas ten or fifteen years ago such engines were very few in number and very uncertain in results, at the present time they probably outnumber engines of all other kinds, and in point of efficiency they are an undisputed success. The use of denatured alcohol in such engines, it is hoped, will greatly decrease the cost of operation



INSPECTING WORK OF STUDENTS—PUTTING IN TUBES

CLASS IN STEAM ENGINEERING—MORNING LECTURE

and will increase the number used. Instruction in the construction and operation of gasoline and other engines of this class will be given throughout the term. The use of the gasoline traction engine will also be taught, and practical work on it will be given.

Those who complete the work with the gasoline engine will be given a special certificate for that course.

BLACKSMITHING

The competent engineer should know how to handle iron at the forge. He should be able to weld when the necessity arises and to temper his tools skillfully. To the students of this course a series of practical exercises will be offered covering the elements of iron and steel forging, tool making and tempering. The aim will be to make the course as useful as possible to threshermen and engineers.

BABBITTING

Lectures will be given on babbitt and babbitting. Each student will be required to do actual work in babbitting boxes.

BELT-LACING

Demonstrated lectures are given on the speed of pulleys, belting and belt-lacing. Students are required to figure speed of pulleys and make samples of the belt-lacing in common use.

PIPE-FITTING

Demonstrated lectures are given on pipe-fitting, valves, etc. Students are required to cut and thread pipes and do some work in pipe-fitting.

ROPE SPLICING

Every thresherman and engineer should know how to splice a rope and to tie all the useful knots known to the sailor. A series of lessons in this art will be given covering all the common knots and splices.

SOLDERING

Demonstrated lectures are given on tinning, making soldering acids and soldering iron. Students are required to solder samples of various metals, etc.

TUBE SETTING

Instruction in tube setting is given, and students are required to put in and remove tubes.

STUDENT AT FORGE—BLACKSMITH SHOP

SPECIAL FEATURES

The regular school session will be held every day in the week, from 8:15 to 4:30, but Saturday afternoons will be devoted to visiting places of interest in and about the Twin Cities, under the direction of the instructors in the school.

Some of these places will be:

The Minnesota State Capitol, and its power plant for lighting and heating;

The state prison at Stillwater, and the manufacturing plants in connection with it;

The factory of the Northwest Thresher Co.;

The power plant of the Twin City Rapid Transit Co.;

Pillsbury A Mill, the largest flour mill in the world;

Minnehaha Falls and Fort Snelling;

Factory of the Minneapolis Threshing Machine Co., at Hopkins, where the processes in the manufacture of boilers, engines and separators may be illustrated.

LICENSE

A number of states require any man who runs an engine to obtain a license based on an examination held by an inspector. The State of Minnesota has such a law:

"Any person who shall operate any steam boiler or steam machinery of any kind without first obtaining a license from an inspector, shall be deemed guilty of a misdemeanor, and fined not less than twenty-five dollars nor more than fifty dollars."

Engineers shall be divided into four classes, namely:

Chief Engineers;

First Class Engineers;

Second Class Engineers;

Special Engineers.

Chief Engineers must have had at least five years' actual experience, and must be qualified to take charge of all classes of steam boilers and steam machinery.

First Class Engineers must have had at least three years of experience, and must show that they are qualified to take charge of all classes of steam boilers and steam machinery not exceeding 300 horse-power.

Second Class Engineers must have had at least one year of actual experience, and be licensed to operate boilers and steam machinery not to exceed 100 horse-power.

Special Engineers, if found competent on examination, are licensed to operate steam boilers and steam machinery not to exceed 30 horse-power.

Pupils who take the course in this school and receive the diploma after examination will receive an engineer's second class license. If the length of service warrants it, first class and chief engineer's licenses will be issued.

Licenses will be issued by the Board of State Boiler Inspectors on payment of the legal fee of $1.00.

The licenses issued in this state will be accepted by most of the states as evidence of qualification to operate steam boilers and steam engines.

THE SCHOOL OF AGRICULTURE

The School of Agriculture was organized to fit young men and women for successful farm life, and to give its students the necessary preparation for useful citizenship.

The course requires three winters of six months each for completion, and is co-educational. Much of the work is taken in common by the young men and the young women. Some of the subjects, such as blacksmithing, carpentry, field work and

handling grain and machinery, are taken by the young men, while the young women pursue cooking, sewing, laundering and household art. The methods of instruction tend to educate students toward the farm instead of away from it, and to develop in them a love for farm life by showing them its possibilities.

DAIRY SCHOOL

The next session of the Dairy School will open Monday, November 16, 1908, and continue four weeks.

This course is designed to furnish persons who are actually engaged in the manufacture of butter and cheese in creameries and cheese factories an opportunity to become more skilled in their work and also to study the many problems which have a direct bearing upon the dairy industry. Recognizing the fact that such persons cannot be away from business for a long period, the term has been so arranged that the time of each student is fully occupied by lectures and actual work in the creamery training room every hour of every working day of the term.

SHORT COURSE FOR FARMERS

The Short Course for Farmers is held for four weeks, beginning January 15, 1909. It is designed to interest those of mature years who are actively engaged in farm work, and are ambitious to become familiar with the most recent agricultural thought and practice. The selection of topics is very carefully made to cover the ground in as complete and thorough a manner as possible. The work is given in lecture form, including such subjects as stock and grain judging, horticulture, study of soils and fertilizers, and other matters of vital interest to the farmer.

SHORT COURSE FOR TEACHERS

The Short Summer Course for Teachers, Principals and Superintendents is established to meet the demand for agricultural instruction by educators who wish to teach the elements of agriculture, or who wish to be able to supervise the teaching of the subject intelligently in the public schools. It is intended to be especially helpful to teachers who desire to be more efficient in teaching the elements of agriculture in rural schools, or in small village schools having an attendance largely from the country.

The session opens June 21st and continues for three weeks.

COLLEGE OF AGRICULTURE

The College of Agriculture provides a four years' course parallel with other colleges of the University. It opens in September and closes in June.

The course in Agriculture is designed to give the student a broad education in the sciences and arts relating to Agriculture, and to fit him for the work of the agricultural specialist.

SUMMER SCHOOL OF FORESTRY

The Summer School of Forestry is held in Itasca Park, opening July 1 and continuing for six weeks. It provides instruction in forestry for those who can profit by a short, practical course in this subject under the best conditions.

INQUIRIES

Anyone desiring further information in regard to these courses may apply to Jas. M. Drew, Registrar, University Farm, St. Paul, Minn.

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Department of Agriculture

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ALBERT F. WOODS, A. M. - - - - - - - - Dean

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WM. BOSS, - - - - - - Steam Engineering

J. L. MOWRY, - - - - - - Gasoline Engineering

H. B. WHITE, - - - - - - - Field Practice

JAS. M. DREW, - - - - Blacksmithing, Rope Splicing

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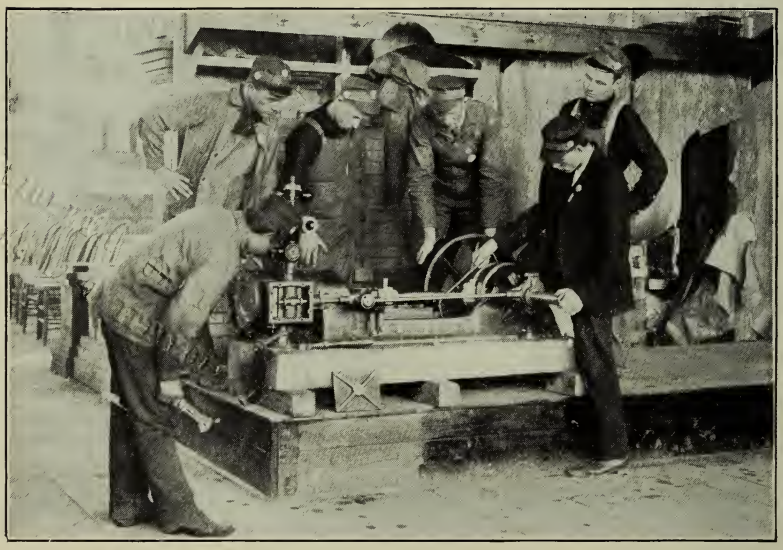
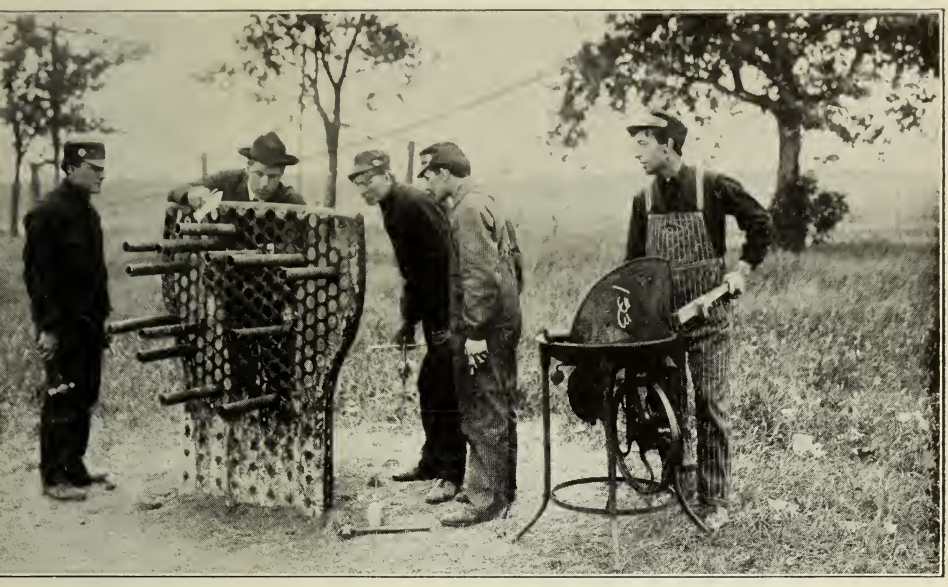


SETTING SLIDE VALVE



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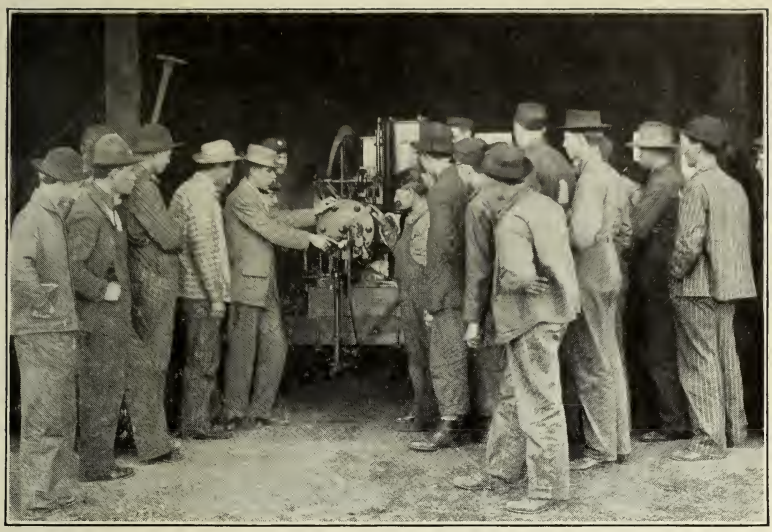

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GROUP OF STUDENTS ON ENGINE

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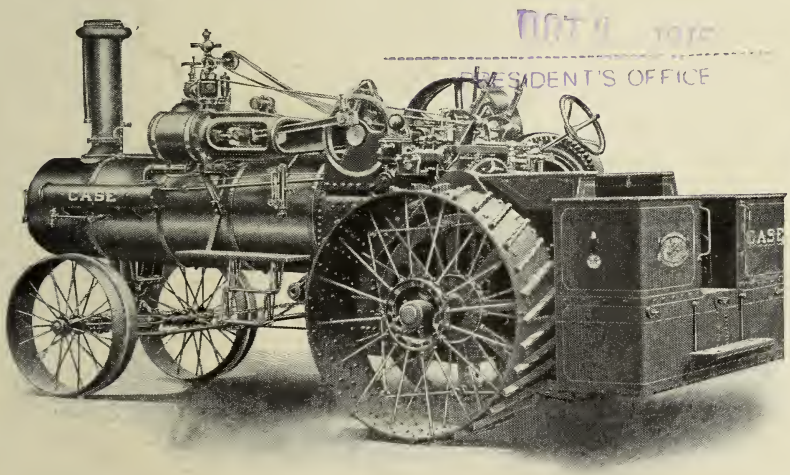
The University of Minnesota Bulletin

Department of Agriculture.

SHORT COURSE IN TRACTION ENGINEERING,

May 23d to June 16th, 1911.

UNIVERSITY OF ILLINOIS
PRESIDENT'S OFFICE



1911.

UNIVERSITY FARM,

St. Paul, Minnesota.

Entered at the Postoffice in Minneapolis as second-class matter.
MINNEAPOLIS, MINN.

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C. D. DECKER, Austin, - - - - Secretary of the Board.

ALBERT F. WOODS, A. M., - - - - - - - - Dean.

FACULTY.

Division of Agricultural Engineering, College of Agriculture.

J. L. MOWRY, Instructor in Charge.

J. B. FREAR, - - - - - - - - - Steam Engineering.

J. L. MOWRY, - - - - - - - - - Gasoline Engineering.

H. B. White, - - - - - - - - - - Field Practice.

A. D. JOHNSTON, - - - - - - - - - Blacksmithing.

THE SHORT COURSE IN TRACTION ENGINEERING.

The growing use of traction engines in general farm work has made it advisable to offer a special course in the use of power machinery as one of the "short courses" in the Department of Agriculture of the University of Minnesota.

The course is complete in itself, covering four weeks of study and practice. The mornings are devoted to lectures and classroom work, and the afternoons to actual practice in the various departments, under the supervision of the instructors of the school.

Such a course opens a great opportunity to the young man interested in mechanics, who has had some practical experience in the handling of engines; enabling him to acquire in a short time valuable training in the theory and practice of engineering.

LOCATION AND EQUIPMENT.

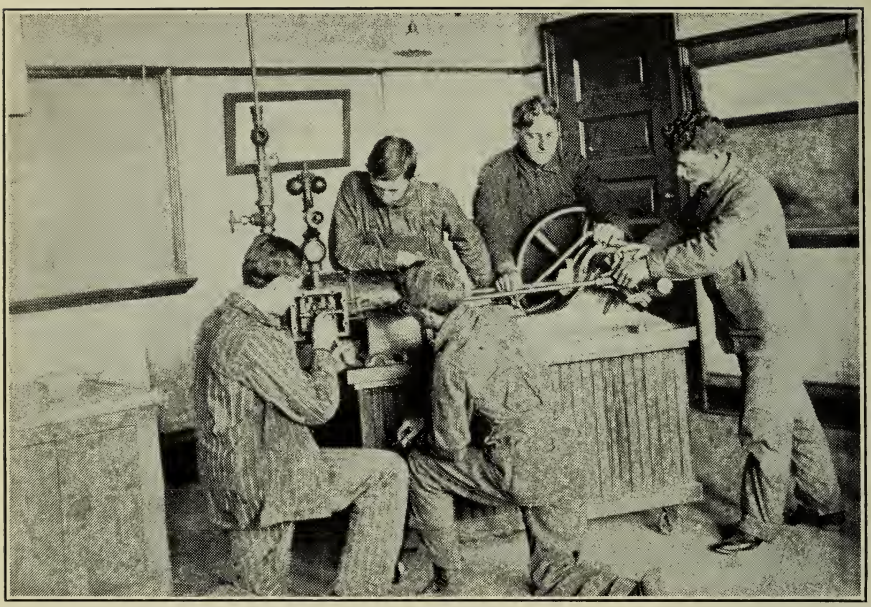
The short course in traction engineering is held at University Farm, St. Paul, midway between St. Paul and Minneapolis; a ten-minute walk from the car line. To reach the farm, take the Como-Harriet or Como-Hopkins car from either city and get off at Commonwealth Avenue.

The entire equipment and the staff of the Division of Agricultural Engineering are at the disposal of this Course, and provide a splendid opportunity for pursuing the work.

Located as it is between the two great cities of the Northwest, the students find every facility at hand to enable them to become proficient engineers.

EXPENSE OF COURSE.

The tuition for the entire course is fifteen dollars, payable as a registration fee at the time of entrance. This covers instruction in all departments—traction, stationary and gas engines. No deduction is made if the student elects but a part of the course, or fails to complete work from any cause whatever.



Squad Setting Slide Valve—Steam Engine.

Each student is required to furnish work-clothes, overalls and gloves, and be prepared for the expense of car-fare on trips of inspection to factories, etc.

ARRANGEMENTS FOR ACCOMMODATION.

Good board and room will be furnished on the campus of the school for $3.50 per week. The large dining-hall at the school will be in service, and the dormitory rooms may be used under proper regulations. The rooms have all necessary furniture and equipment.

This arrangement will keep all the students together, and will allow more time for the practice-work in all departments.

INQUIRIES.

Students wishing to register for the course, or desiring further information, should apply to John T. Stewart, University Farm, St. Paul, Minn.

REQUIREMENTS FOR ADMISSION.

Any person of good moral character, who can read, write, add, multiply, subtract, and divide, and who has had one season's experience with plowing or threshing outfits, may be admitted to this school.

Application for admission should be made by letter to John T. Stewart, University Farm, St. Paul, Minnesota.

Any not applying by letter, giving age, schooling, and experience, will take their own chances of gaining entrance.

A knowledge of Algebra and Physics is not necessary, but can be made good use of.

The work is made so simple and plain that those with the above limited education, required for admission, can pursue the course with profit.

TIME OF SESSION.

The Short Course in Traction Engineering opens Tuesday, May 23, and continues for four weeks, closing Friday, June 16, 1911. Those desiring to take the course should register and secure boarding places Monday, May 22, as work begins promptly Tuesday morning.

COURSE OF STUDY.

STEAM ENGINES.

Steam.—Properties of steam, the steam table, latent heat of vaporization, total heat of vaporization, specific volume of steam, work done by steam, work diagrams, expansion of steam.

Boilers.—Types of boilers: Steam boiler, locomotive boiler, return-flue boiler, the vertical boiler. Construction and repairing of boilers. Boiler materials. Riveted joints, staying flat surfaces, tubes and tube sheets. Boiler fittings: Fusible plugs, grates, safety valve, steam and water gauges, the whistle. Boiler feeders: Pumps, the injector.

Combustion of Fuels.—The process of combustion; igniting temperature; products of combustion; combustion of carbon, complete; combustion of carbon, incomplete; combustion of hydrogen; heat of combustion; temperature of combustion; conditions required for economical combustion. Fuels. Firing.

The Traction Steam Engine.—The mechanism of the steam engine. The slide-valve and steam distribution: Outside lap, inside lap, angle of advance, effects of lap, lead, position of the eccentric, rocker-arms; direct and indirect valves; setting the slide-valve; dead centers; to place the engine on its dead

GENERAL V

center; directions for setting slide-valve. Reversing gears: Single-eccentric reversing gear; the Stephenson ling motion. Compound engines: Efficiency of heat engines; absolute zero; absolute temperature; principles of the compound engine; compound traction engines. Various details of the traction engine: The traction gearing; compensation gear; drive wheels; the governor; cylinder lubricators. Operation and care of the traction engine: General examination; the boiler; feedwater; exhaust nozzles; use of the whistle; the engine; starting the engine; the engine on the road; guiding the engine; the friction clutch; setting the engine; connecting-rod brasses; tests for leaks; friction and lubrication; winter care of the engine; portable engines.

Indicators and Indicator Diagrams.—Description of the indicator. Direction for using the indicator: Reducing motion; directions for taking indicator diagrams; points and lines of the diagram. Horse-power: Mean effective pressure; approximate determination of mean effective pressure; piston speed; friction horse-power; net horse-power; mechanical efficiency. To find the traction force of a traction engine. Reading

BUILDINGS.

indicator diagrams. Operation of traction engine: Ascending and descending hills, pulling load in the sand, in mud, over bridges, getting out of a sink hole, etc.

GASOLINE ENGINES.

Mechanism of the Gasoline Engine.—Piston; Valves, automatic and mechanical; Cam; Timing; Cycle, two and four cycle.

Gas Fuels.—Gasoline; Kerosene; Distillate Alcohol; Storage.

Governors.—Hit or miss; Throttling; Volume.

Carburettion.—Carburetters; Types; Pressure and Gravity Feeds.

Electricity.—Systems of Ignition; Dry Cells; Wet Cells; Storage Batteries; Dynamos; Magnetos; High and Low Tension; Connections; Circuits; Grounds; Jump Spark; Make and Break; Spark-Plugs; Spark-Coils; Vibrators; Timing of Ignition.

Cooling.—Water; Air; Oil; Anti-freezing Solutions.

Lubricants.—Lubrication, Choice of.

Multiple Cylinder.—Balance; Order of Firing.

Gasoline Traction.—Clutches; Transmission; Drives; Chain and Gear.

Students at Forge—Blacksmith Shop.

Within the past few years, engines using the explosive power of gas as the means of securing mechanical motion have come into very extensive use. Whereas, ten or fifteen years ago, such engines were very few in number and very uncertain in results, at the present time they probably outnumber engines of all other kinds, and in point of efficiency they are an undisputed success. Instruction in the construction and operation of gasoline and other engines of this class will be given throughout the term.

BLACKSMITHING.

The competent engineer should know how to handle iron at the forge. He should be able to weld when the necessity arises, and to temper his tools skillfully. To the students of this course a series of practical exercises will be offered covering the elements of iron and steel forging, tool-making and tempering. The aim will be to make the course as useful as possible to threshermen and engineers.

BABBITTING.

Lectures will be given on babbitt and babbitting. Each student will be required to do actual work in babbitting boxes.

Punching and Lacing Belts.

BELT-LACING.

Demonstration lectures are given on the speed of pulleys, belting and belt-lacing. Students are required to figure speed of pulleys and make samples of the belt-lacing in common use.

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Demonstration lectures are given on pipe-fitting, valves, etc. Students are required to cut and thread pipes, and to do some work in pipe-fitting.

ROPE SPLICING.

Every thresherman and engineer should know how to splice a rope and to tie all the useful knots known to the sailor. A series of lessons in this art will be given, covering all the common knots and splices.

SOLDERING.

Demonstration lectures are given on tinning, making soldering acids and soldering iron. Students are required to solder samples of various metals, etc.

TUBE-SETTING.

Instruction in tube-setting is given, and students are required to put in and remove tubes.

SPECIAL FEATURES.

The regular school session will be held every day in the week, from 8:15 to 4:30; but Saturday afternoon will be devoted to visiting places of interest in and about the Twin Cities, under the direction of the instructors in the school.

Some of these places will be:

The Minnesota State Capitol, and its power-plant for lighting and heating.

The State Prison at Stillwater, and the manufacturing plants in connection with it.

The factory of the Northwest Thresher Co.

The power plant of the Twin City Rapid Transit Co.

Pillsbury A Mill, the largest flour mill in the world.

The factory of the Minneapolis Threshing Machine Co., at Hopkins, where the processes in the manufacture of boilers, engines and separators may be observed.

LICENSE.

A number of states require any man who runs an engine to obtain a license, based on an examination held by an inspector. The State of Minnesota has such a law:

"Any person who shall operate any steam boiler or steam machinery of any kind, without first obtaining a license from an inspector, shall be deemed guilty of a misdemeanor, and fined not less than twenty-five dollars nor more than fifty dollars."

Engineers shall be divided into four classes, namely:

Chief Engineers;

First-Class Engineers;

Second-Class Engineers;

Special Engineers.

Chief Engineers must have had at least five years' actual experience, and must be qualified to take charge of all classes of steam boilers and steam machinery.

First-Class Engineers must have had at least three years of experience, and must show that they are qualified to take charge of all classes of steam boilers and steam machinery not exceeding 300 horse-power.

Second-Class Engineers must have had at least one year of actual experience, and be licensed to operate boilers and steam machinery not to exceed 100 horse-power.

Special Engineers, if found competent on examination, are licensed to operate steam boilers and steam machinery not to exceed 30 horse-power.

Pupils who take the course in this school, and receive the diploma after examination, may receive an engineer's second-class license. If the length of service warrants it, first-class and chief engineer's licenses will be issued.

Licenses will be issued by the Board of State Boiler Inspectors on payment of the legal fee of $1.

The licenses issued in this state will be accepted by most of the states as evidence of qualification to operate steam boilers and steam engines.

SCHOOLS AND COURSES.

THE SCHOOL OF AGRICULTURE.

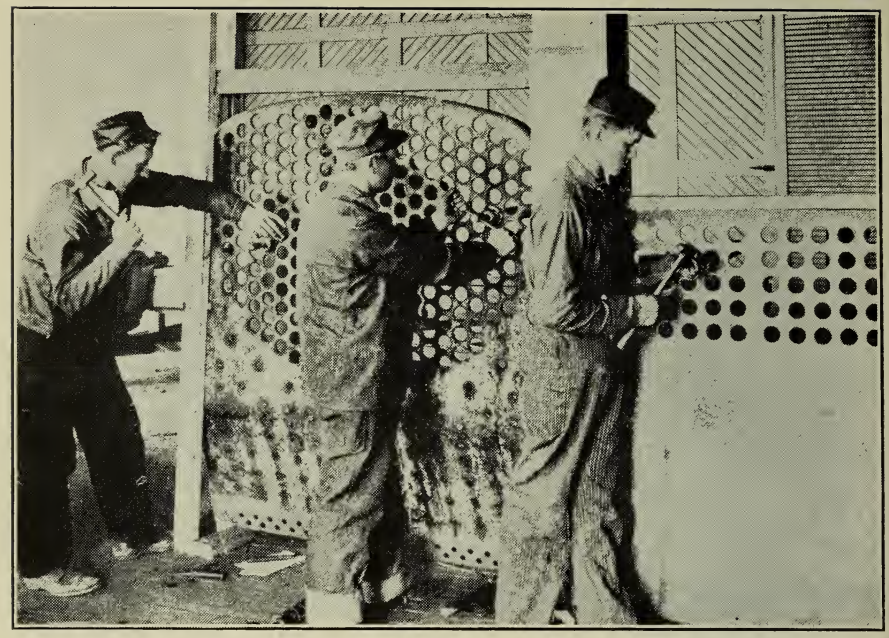
The School of Agriculture was organized to fit young men and women for successful farm life, and to give its students the necessary preparation for useful citizenship.

The course requires three winters of six months each for completion, and is co-educational. Much of the work is taken in common by both the young men and young women. Some of the subjects, such as blacksmithing, carpentry, field work, and handling grain and machinery, are taken by the young men; while the young women pursue cooking, sewing, laundering and household art. The methods of instruction tend to educate students toward the farm instead of away from it, and to develop in them a love for farm life by showing them its possibilities.

DAIRY SCHOOL.

The next session of the Dairy School will open Monday, November 13, 1911, and continue four weeks.

This course is designed to furnish persons who are actually engaged in the manufacture of butter and cheese, in creameries and cheese factories, an opportunity to become more skilled in their work, and also to study the many problems which have a direct bearing upon the dairy industry. Recognizing the fact that



Setting Boiler Tubes.

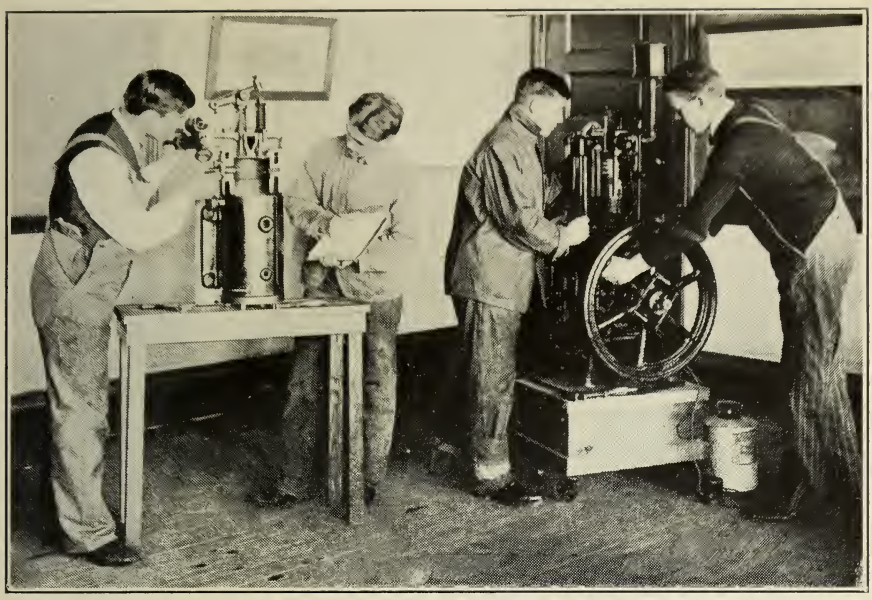
such persons cannot be away from business for a long period, the term has been so arranged that the time of each student is fully occupied by lectures and actual work in the creamery training-room every hour of every working day of the term.

SHORT COURSE FOR FARMERS.

The Short Course for Farmers is held for four weeks, beginning January 23, 1911. It is designed to interest those of mature years who are actively engaged in farm work, and are ambitious to become familiar with the most recent agricultural thought and practice. The selection of topics is very carefully made, to cover the ground in as complete and thorough a manner as possible. The work is given in lecture form, including such subjects as stock and grain judging, horticulture, study of soils and fertilizers, and other matters of vital interest to the farmer.

SHORT COURSE FOR TEACHERS.

The Short Summer Course for Teachers, Principals and Superintendents is established to meet the demand for agricultural instruction by educators who wish to teach the elements of agriculture, or who wish to be able to supervise the teaching of the



Timing Valves and Spark—Gasoline Engine.

subject intelligently in the public schools. It is intended to be especially helpful to teachers who desire to be more efficient in teaching the elements of agriculture in rural schools, or in small village schools having an attendance largely from the country.

The session opens June 19, 1911, and continues for six weeks.

COLLEGE OF AGRICULTURE.

The College of Agriculture provides a four years' course parallel with other colleges of the University. It opens in September and closes in June.

The course in Agriculture is designed to give the student a broad education in the sciences and arts relating to Agriculture, and to fit him for the work of the agricultural specialist.

SUMMER SCHOOL OF FORESTRY.

The Summer School of Forestry is held in Itasca Park, opening July 1 and continuing for six weeks. It provides instruction in forestry for those who can profit by a short, practical course in this subject, under the best conditions.

INQUIRIES.

Anyone desiring further information in regard to these courses may apply at University Farm, St. Paul, Minn.

MORNING LECTURE.

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SHORT COURSE IN TRACTION ENGINEERING

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Division of Agricultural Engineering.

JOHN T. STEWART, C. E., Professor and Chief.

J. L. MOWRY, Instructor in Charge, Short Course in Traction Engineering.

J. B. FREAR, - - - - - - - - - Steam Engineering.

J. L. MOWRY, - - - - - - - Gasoline Engineering.

H. B. WHITE, - - - - - - - - - Field Practice.

A. D. JOHNSTON, - - - - - - - - Blacksmithing,

GENERAL VIEW OF BUILDINGS

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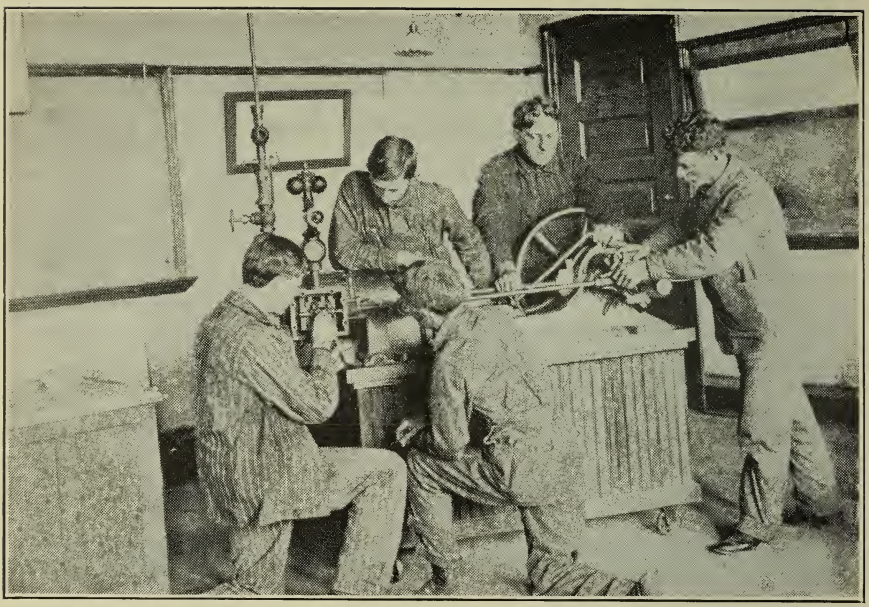

Squad Setting Slide Valve—Steam Engine.

ARRANGEMENTS FOR ACCOMMODATION.

Good board and room will be furnished on the campus of the school for $14.00 for the month. The large dining-hall at the school will be in service, and the dormitory rooms may be used under proper regulations. The rooms have all necessary furniture and equipment.

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Any person of good moral character, who can read, write, add, multiply, subtract, and divide, and who has had one season's experience with plowing or threshing outfits, may be admitted to this school.

Application for admission must be made by letter to J. L. Mowry, University Farm, St. Paul, Minnesota, using the blank found in this Bulletin.

A knowledge of Algebra and Physics is not necessary, but can be made good use of.

The work is made so simple and plain that those with the above limited education, required for admission, can pursue the course with profit.

TIME OF SESSION.

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COURSE OF STUDY.

PHYSICS.

Elementary physics is studied sufficient to enable the students to understand the work given on boilers and engines as the following outline will show:

Matter, Properties of Matter, Molecules, Atoms, Solid Bodies, Liquid Bodies, Gaseous Bodies, Vapor, Temperature, Absolute Temperature, Absolute Zero, Position of Zero Point on Various Thermometers, Heat, Unit of Heat, Work, Horse Power, Pressure, Air Pressure, Gauge Pressure, Absolute Pressure, Circulation of Air, Vacuum, Steam, Dry Steam, Expansion of Steam and Gases, Condensation of Steam, Sensible Heat, Latent Heat, Total Heat, Boiling Point, Effect of Vacuum or Pressure on Boiling Point, Combustion of Fuels, Ignition Temperature, Products of Combustion, Combustion of Carbon, Combustion of Nitrogen, Heat of Combustion, Temperature of Combustion.

STEAM BOILERS.

Classification.—As to location of fire, water, movability, construction, size.

Horizontal Return Tubular Boiler.—Construction, size, setting and supporting, advantages, disadvantages.

Fire Box Boilers.—Types, construction, size, advantages, disadvantages.

Water Tube Boilers.—Construction, types, size, setting and supporting, advantages, disadvantages.

Boiler Calculations.—How to calculate, safe working pressure, heating surface, grate surface, horse power.

Boiler Fittings and Accessories.—Safety valves, gauge cocks, glass gauge, water column, steam gauge, fusible plug, injectors, whistle, valves, blow-off pipe, feed pipe, blower, manholes, hand-holes, washout plugs, seam domes, steam drums, mud drum, super-heaters, feed water feeders, steam traps, steam separators, condensers, reducing valves.

FIE

Operation of Boilers.—Cleaning, repairing, boiler troubles, firing, boiler testing and inspection, laws regarding operation and licenses.

PUMPS.

Classification.—Lift pumps, single acting, double acting, duplex, cross-head, belted or geared.

Construction.—Types of valves, number of valves, inside packed, outside packed, types of steam ends.

Pump Calculations.—Height to which they will draw water; amount of water pumped; size of pistons and plungers; steam pressure required.

Operation.—Speed, repairing, troubles, setting steam valves.

STEAM ENGINES.

Classification.—Reciprocating, rotary, oscillating, condensing, non-condensing, simple slide valve, piston valve, Corliss valve gear, compound, triple expansion.

Construction and Use of.—Bed, cylinder, piston, slide valve, eccentric, connecting rod, crank, etc.

Valve Setting.—Dead center, outside lap, inside lap, lead, point of cut-off, position of eccentric, angle of advance, setting valves with reverse gears.

ICE.

Governors.—Purpose, types, construction, operation, troubles, adjusting, care.

Engine Calculations.—Use of steam indicator, mean effective pressure, reading indicator cards, horse power, tractive force.

Operation.—Starting, stopping, adjustment of parts, care. Special attention is given to traction engines.

GASOLINE ENGINES.

Mechanism of the Gasoline Engine.—Piston; Valves, automatic and mechanical; Cam; Timing; Cycle, two and four cycle.

Gas Fuels.—Gasoline; Kerosene; Distillate; Alcohol; Storage.

Governors.—Hit or miss; Throttling; Volume.

Carburettion.—Carburetters; Types; Pressure and Gravity Feeds.

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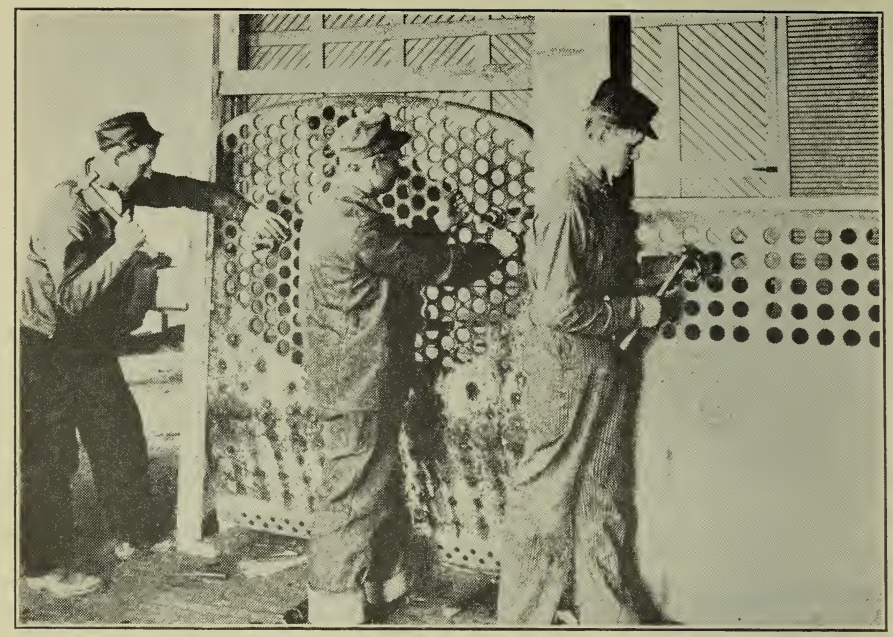
The course requires three winters of six months each for completion, and is co-educational. Much of the work is taken in common by both the young men and young women. Some of the subjects, such as blacksmithing, carpentry, field work, and handling grain and machinery, are taken by the young men; while the young women pursue cooking, sewing, laundering and household art. The methods of instruction tend to educate students toward the farm instead of away from it, and to develop in them a love for farm life by showing them its possibilities.

DAIRY SCHOOL.

The next session of the Dairy School will open Monday, November 11, 1912, and continue four weeks.

This course is designed to furnish persons who are actually engaged in the manufacture of butter and cheese, in creameries and cheese factories, an opportunity to become more skilled in their work, and also to study the many problems which have a direct bearing upon the dairy industry. Recognizing the fact that such persons cannot be away from business for a long period, the term has been so arranged that the time of each student is fully occupied by lectures and actual work in the creamery training-room every hour of every working day of the term.



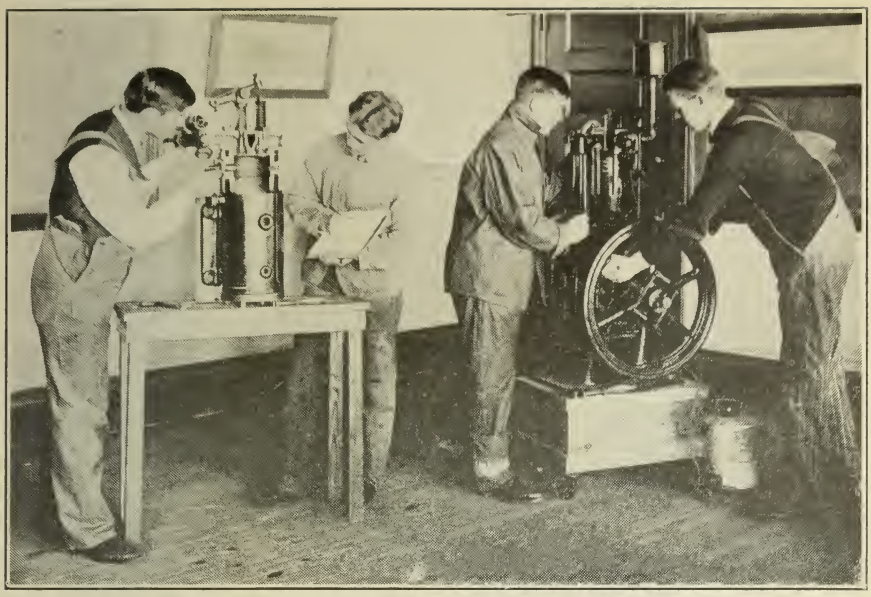
Setting Boiler Tubes.

SHORT COURSE FOR FARMERS.

The Short Course for Farmers is held for four weeks, beginning January 21, 1913. It is designed to interest those of mature years who are actively engaged in farm work, and are ambitious to become familiar with the most recent agricultural thought and practice. The selection of topics is very carefully made, to cover the ground in as complete and thorough a manner as possible. The work is given in lecture form, including such subjects as stock and grain judging, horticulture, study of soils and fertilizers, and other matters of vital interest to the farmer.

SHORT COURSE FOR TEACHERS.

The Summer Short Course for Teachers, Principals and Superintendents is establised to meet the demand for agricultural instruction by educators who wish to teach the elements of agriculture, or who wish to be able to supervise the teaching of the subject intelligently in the public schools. It is intended to be especially helpful to teachers who desire to be more efficient in teaching the elements of agriculture in rural schools, or in small village schools having an attendance largely from the country.



Timing Valves and Spark—Gasoline Engine.

The session opens June 17, 1912, and continues for six weeks.

COLLEGE OF AGRICULTURE.

The College of Agriculture provides a four years course parallel with other colleges of the University. It opens in September and closes in June.

The course in Agriculture is designed to give the student a broad education in the sciences and arts relating to Agriculture, and to fit him for the work of the agricultural specialist.

INQUIRIES.

Anyone desiring further information in regard to these courses may apply to J. M. Drew, Registrar, University Farm, St. Paul, Minn.

1911 CLASS.

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1913

The University of Minnesota

DEPARTMENT OF AGRICULTURE

SHORT COURSE IN TRACTION ENGINEERING

May 6 to June 6, 1913

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UNIVERSITY FARM, ST. PAUL
FEBRUARY, 1913
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THE UNIVERSITY OF MINNESOTA

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George Edgar Vincent, Minneapolis - - - - - - - *Ex-Officio*
The President of the University
The Hon. Adolph O. Eberhart, Mankato - - - - - *Ex-Officio*
The Governor of the State
The Hon. C. G. Schulz, St. Paul - - - - - - - - *Ex-Officio*
The State Superintendent of Public Instruction
The Hon. W. J. Mayo, Rochester - - - - - - - - - 1913
The Hon. Milton M. Williams, Little Falls - - - - - - 1913
The Hon. John G. Williams, Duluth - - - - - - - - 1914
The Hon. A. E. Rice, Willmar - - - - - - - - - - 1915
The Hon. Charles L. Sommers, St. Paul - - - - - - - 1915
The Hon. B. F. Nelson, Minneapolis - - - - - - - - 1916
The Hon. Pierce Butler, St. Paul - - - - - - - - - 1916
The Hon. Fred B. Snyder, Minneapolis - - - - - - - - 1916

DIVISION OF AGRICULTURAL ENGINEERING

FACULTY

George Edgar Vincent, Ph.D., LL.D. - - - - - - - President
Albert F. Woods, M.A. - - - - - - - - - - - - - Dean
John T. Stewart, C.E. - - - - - Professor and Chief of Division
J. L. Mowry - - - - - - - - - - - - - - - - -
In Charge Short Course in Traction Engineering; Gasoline Engines
J. B. Frear, M.E. - - - - - - - - - - - - Steam Engines
H. B. White, B.S. - - - - - - - - - - - - Field Practice
A. D. Johnston - - - - - - - - - - - - Blacksmithing
L. R. Whitson, E.M. - - - - - - - - - - - - - Physics

THE SHORT COURSE IN TRACTION ENGINEERING

The growing use of traction engines in general farm work has made it advisable to offer a special course in the use of power machinery as one of the "short courses" in the Department of Agriculture of the University of Minnesota.

The course is complete in itself, covering five weeks of study and practice. The mornings are devoted to lectures and classroom work, and the afternoons to actual practice under the supervision of the instructors of the School.

Such a course offers a great opportunity to the young man interested in mechanics, who has had some practical experience in the handling of engines, enabling him to acquire in a short time valuable training in the theory and practice of traction work.

LOCATION AND EQUIPMENT

The short course in traction engineering is held at University Farm, St. Paul, midway between St. Paul and Minneapolis, a ten-minute walk from the car line. To reach the farm, take the Como-Harriet or Como-Hopkins car from either city and get off at Carter Avenue.

Located as it is between the two great cities of the Northwest, the students find every facility at hand to enable them to become proficient engineers.

EXPENSE OF COURSE

The tuition for the entire course is fifteen dollars, payable as a registration fee at the time of entrance. This covers instruction in all departments, traction, stationary and gas engines. No deduction is made if the student elects but a part of the course, or fails to complete work from any cause whatever.

Each student is required to furnish work-clothes, overalls, gloves, and note books, and be prepared for the expense of carfare on trips of inspection to factories and other points of interest.

GENERAL VIEW OF BUILDINGS

BOARD AND ROOM

Good board and room will be furnished on the campus for $17.50 for the term. The rooms have all necessary furniture and equipment. This arrangement will keep all the students together, and will allow more time for the practice work in all departments.

REQUIREMENTS FOR ADMISSION

Any person of good moral character who can read, write, add, multiply, subtract, and divide, and who has had one season's experience with plowing or threshing outfits, or its equivalent in other lines, may be admitted to this School.

A knowledge of Algebra and Physics is helpful but not necessary.

The work is made so simple and plain that those with this limited education required for admission can pursue the course with profit.

Application for admission must be made by letter to J. L. Mowry, University Farm, St. Paul, Minnesota, using the blank at the back of this Bulletin.

TIME OF SESSION

The Short Course in Traction Engineering opens Tuesday, May 6, and continues for five weeks, closing Friday, June 6, 1913. Those desiring to take the course should register and secure boarding places Monday, May 5, as work begins promptly Tuesday morning.

COURSE OF STUDY

PHYSICS

Elementary physics is studied sufficiently to enable the students to understand the work given on boilers and engines as the following outline will show:

Matter, properties of matter, molecules, atoms, solid bodies, liquid bodies, gaseous bodies, vapor, temperature, absolute temperature, absolute zero, position of zero point on various thermometers, heat, unit of heat, work, horse power, pressure,

air pressure, gauge pressure, absolute pressure, circulation of air, vacuum, steam, dry steam, expansion of steam and gases, condensation of steam, sensible heat, latent heat, total heat, boiling point, effect of vacuum or pressure on boiling point, combustion of fuels, ignition temperature, products of combustion, combustion of carbon, combustion of nitrogen, heat of combustion, temperature of combustion.

STEAM BOILERS

Classification.—Based on location of fire and water, movability, construction, size.

Horizontal Return Tubular Boiler.—Construction, size, setting and supporting, advantages, disadvantages.

Fire Box Boilers.—Types, construction, size, advantages, disadvantages.

Water Tube Boilers.—Construction, types, size, setting and supporting, advantages, disadvantages.

Boiler Calculations.—How to calculate, safe working pressure, heating surface, grate surface, horse power.

Boiler Fittings and Accessories.—Safety valves, gauge cocks, glass gauge, water column, steam gauge, fusible plug, injectors, whistle, valves, blow-off pipe, feed pipe, blower, manholes, hand-holes, washout plugs, steam domes, steam drums, mud drum, super-heaters, feed water feeders, steam traps, steam separators, condensers, reducing valves.

Operation of Boilers.—Cleaning, boiler troubles, repairing, firing, boiler testing and inspection, laws regarding operation and licenses.

PUMPS

Classification.—Lift pumps, single acting, double acting, duplex, cross-head, belted or geared.

Construction.—Types of valves, number of valves, inside packed, outside packed, types of steam ends.

Pump Calculations.—Height to which they will draw water; amount of water pumped; size of pistons and plungers; steam pressure required.

Operation.—Speed, troubles, repairing, setting steam valves.

Squad Setting Slide Valve—Steam Engine

STEAM ENGINES

Classification.—Reciprocating, rotary, oscillating, condensing, non-condensing, simple slide valve, piston valve, Corliss valve gear, compound, triple expansion.

Construction and Use of.—Bed, cylinder, piston, slide valve, eccentric, connecting rod, crank, etc.

Valve Setting.—Dead center, outside lap, inside lap, lead, point of cut-off, position of eccentric, angle of advance, setting valves with reverse gears.

Lubricators and Oil Pumps.—Purpose, types, construction, operation, troubles, adjustment, care.

Governors. — Purpose, types, construction, operation, troubles, adjusting, care.

Engine Calculations.—Use of steam indicator, mean effective pressure, reading indicator cards, horse power, tractive force.

Operation. — Starting, stopping, adjustment of parts, care. Special attention is given to traction engines.

GASOLINE ENGINES

Within the past few years, engines using the explosive power of gas as the means of securing mechanical motion have come into very extensive use. Whereas, ten or fifteen years ago such engines were very few in number and very uncertain in results, at the present time they probably outnumber engines of all other kinds, and in point of efficiency they are an undisputed success. Work in the construction and operation of gasoline and other engines of this class will be given throughout the term.

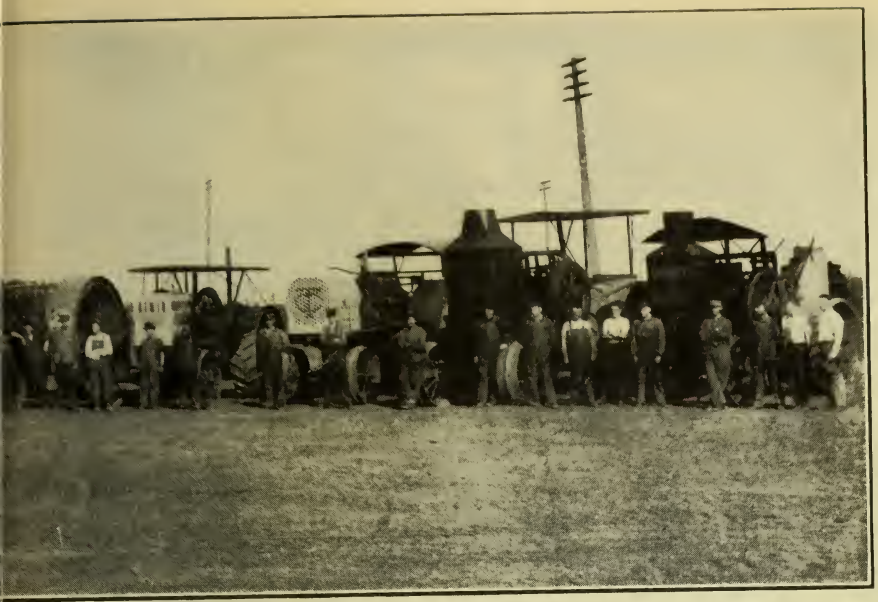
Mechanism of the Gasoline Engine.—Piston, automatic and mechanical valves, cam-timing, two-and-four-cycle.

Gas Fuels.—Gasoline, kerosene, distillate, alcohol, storage.

Governors.—Hit or miss, throttling, volume.

Carburetors.—Types, pressure and gravity feeds.

Systems of Ignition.—Raw flame, hot tube, electric, dry cells, wet cells, storage batteries, dynamos, magnetos, high and low tension, connections, circuits, grounds, jump spark, make and break, spark-plugs, spark-coils, vibrators, timing of ignition.



Cooling.—Water, air, oil, anti-freezing solutions.
Lubricants.—Lubrication systems, choice of.
Multiple Cylinder.—Balance, order of firing.
Gasoline Traction. — Clutches, transmission, chain and gear drives.

BLACKSMITHING

The competent engineer should know how to handle iron at the forge. He should be able to weld when the necessity arises, and to temper his tools skillfully. To the students of this course a series of practical exercises will be offered covering the elements of iron and steel forging, tool-making and tempering. The aim will be to make the course as useful as possible to threshermen and engineers.

BELT-LACING

Demonstration lectures are given on the speed of pulleys, belting, and belt-lacing. Students are required to figure speed of pulleys and make samples of the belt-lacing in common use.

Punching and Lacing Belts

BABBITTING

Lectures will be given on babbitt and babbitting. Each student will be required to do actual work in babbitting boxes.

PIPE-FITTING

Demonstration lectures are given on pipe-fitting, valves, etc. Students are required to cut and thread pipes, and to do some work in pipe-fitting.

ROPE SPLICING

Every thresherman and engineer should know how to splice a rope and to tie all the useful knots known to the sailor. A series of lessons in this art will be given, covering all the common knots and splices.

SOLDERING

Demonstration lectures are given on metals, soldering materials and tools, and their use in soldering. Students are required to solder samples of various metals, etc.

TUBE-SETTING

Instruction in tube-setting is given and students are required to put in and remove tubes.

SPECIAL FEATURES

The regular school session will be held every day in the week, from 8:15 to 4:30; but Saturday afternoon will be devoted to visiting places of interest in and about the Twin Cities, under the direction of the instructors in the School.

Some of these places will be:

The Minnesota State Capitol, and its power-plant for lighting and heating.

The State Prison at Stillwater, and the manufacturing plants in connection with it.

The factories of the Northwest Thresher Company, the Gas Traction Company, and the Minneapolis Steel and Machinery Company.

The power plant of the Twin City Rapid Transit Company.

Pillsbury A Mill, the largest flour mill in the world.

The factory of the Minneapolis Threshing Machine Company, at Hopkins, where the processes in the manufacture of boilers, engines, and separators may be observed.

LICENSE

A number of states require any man who runs an engine to obtain a license, based on an examination held by an inspector. The State of Minnesota has such a law:

"Any person who shall operate any steam boiler or steam machinery of any kind, without first obtaining a license from an inspector, shall be deemed guilty of a misdemeanor, and fined not less than twenty-five dollars nor more than fifty dollars."

Pupils who take the course in this School, and receive the diploma after examination, may receive an engineer's license.

Engineers shall be divided into four classes, namely: Chief Engineers, First-Class Engineers, Second-Class Engineers, and Special Engineers.

Chief Engineers must have had at least five years of actual experience, and must be qualified to take charge of all classes of steam boilers and steam machinery.

First-Class Engineers must have had at least three years of experience, and must show that they are qualified to take charge of all classes of steam boilers and steam machinery not exceeding 300 horse-power.

Second-Class Engineers must have had at least one year of actual experience, and be licensed to operate boilers and steam machinery not to exceed 100 horse-power.

Special Engineers, if found competent on examination, are licensed to operate steam boilers and steam machinery not to exceed 30 horse-power.

Licenses will be issued by the State Boiler Inspector on payment of the legal fee of $1.

The licenses issued in this State will be accepted by most of the states as evidence of qualification to operate steam boilers and steam engines.

OTHER COURSES

THE SCHOOL OF AGRICULTURE

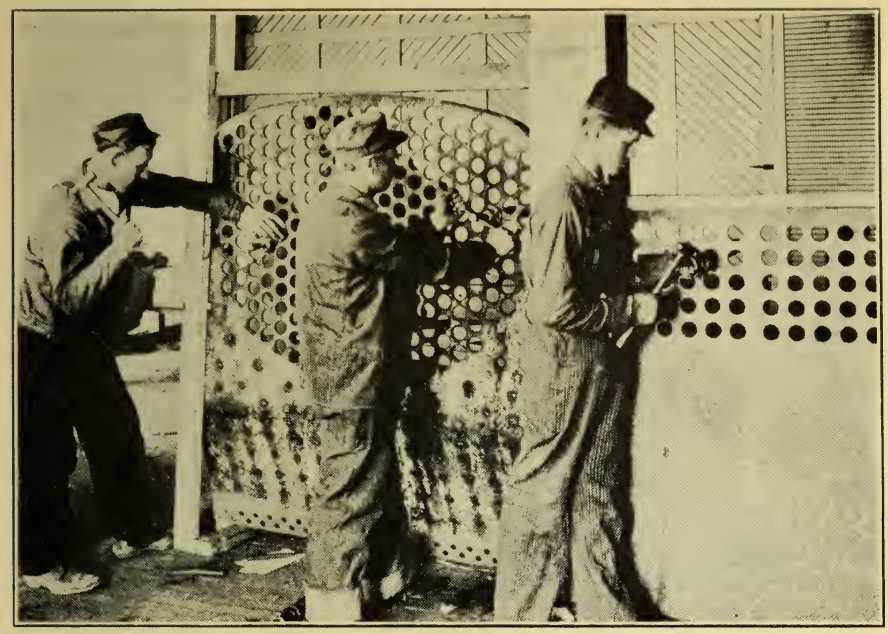
The School of Agriculture was organized to fit young men and women for successful farm life, and to give its students the necessary preparation for useful citizenship.

The course requires three winters of six months each for completion, and is coeducational. Much of the work is taken in common by both the young men and young women. Some of the subjects, such as blacksmithing, carpentry, field work, and handling grain and machinery, are taken by the young men; while the young women pursue cooking, sewing, laundering, and household art. The methods of instruction tend to educate students toward the farm instead of away from it, and to develop in them a love for farm life by showing them its possibilities.

DAIRY SCHOOL

The Dairy School opens before the middle of November and continues four weeks.

This course is designed to furnish persons who are actually engaged in the manufacture of butter and cheese, in creameries and cheese factories, an opportunity to become more skilled in their work, and also to study the many problems which have a direct bearing upon the dairy industry. Recognizing the fact that



Setting Boiler Tubes

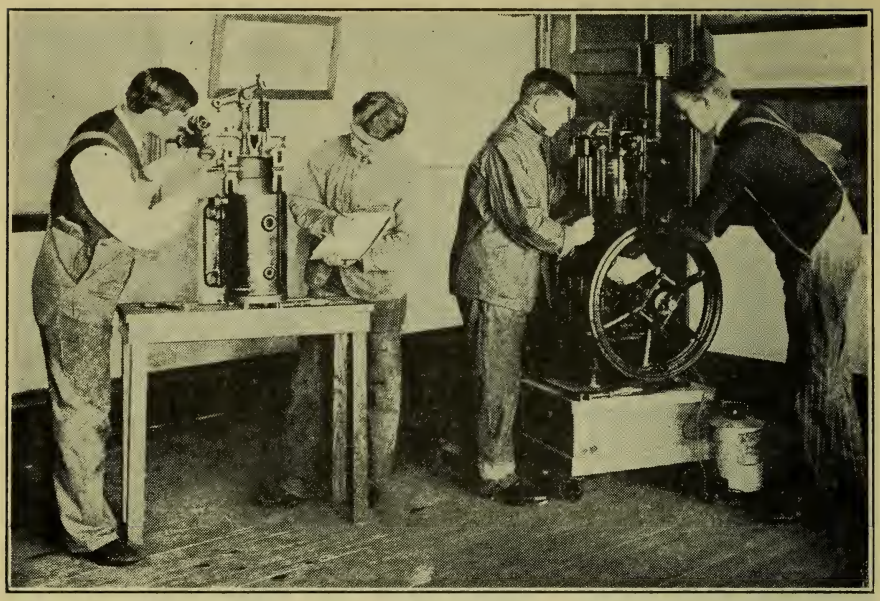
such persons can not be away from business for a long period, the term has been so arranged that the time of each student is fully occupied by lectures and actual work in the creamery training-room every hour of every working day of the term.

JUNIOR SHORT COURSE

A one-week short course for boys and girls is held annually at the University Farm, St. Paul, opening the last Monday in March. The mornings are devoted to class study, the afternoons to excursions to points of interest in the Twin Cities. The cost to the student is three dollars for a week of pleasure and profit. Write for detailed information to the Extension Division, University Farm, St. Paul.

SHORT COURSE FOR FARMERS

The Short Course for Farmers is held for four weeks, starting late in January. It is designed to interest those of mature years who are actively engaged in farm work, and are ambitious



Timing Valves and Spark—Gasoline Engine

to become familiar with the most recent agricultural thought and practice. The selection of topics is very carefully made to cover the essentials of agriculture in as complete and thorough a manner as possible. The work is given in lecture form, including such subjects as stock and grain judging, horticulture, study of soils and fertilizers, and other matters of vital interest to the farmer, and demonstrated by laboratory work as far as possible.

SHORT COURSE FOR TEACHERS

The Summer Short Course for teachers, principals, and superintendents is established to meet the demand for agricultural instruction by educators who wish to teach the elements of agriculture, or who wish to be able to supervise the teaching of the subject intelligently in the public schools. It is intended to be especially helpful to teachers who desire to be more efficient in teaching the elements of agriculture in rural schools, or in small village schools having an attendance largely from the country.

The session opens about the middle of June and continues six weeks.

COLLEGE OF AGRICULTURE

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The course in Agriculture is designed to give the student a broad education in the sciences and arts relating to agriculture, and to fit him for the work of the agricultural specialist.

INQUIRIES

Anyone desiring further information in regard to these courses should apply to J. M. Drew, Registrar, University Farm, St. Paul, Minn.

The University of Minnesota

SCHOOL OF TRACTION ENGINEERING

UNIVERSITY FARM, ST. PAUL

APPLICATION BLANK

Age ..... Occupation ..... yrs.

Nationality ..... Residence in State ..... yrs.

Education - Country School ..... yrs.

City School ..... yrs.

Special School ..... yrs.

Experience - Steam Engines ..... seasons

Sizes and makes

.....

.....

Gasoline Engines ..... yrs.

Sizes and Makes .....

.....

Do you own an engine { Steam / Gasoline } Size .....

Engineer's License ..... Class. ..... yrs.

Do you prefer Gasoline or Steam Engine instruction?

Name .....

P. O. .....

Fill in above blank and send to

J. L. Mowry, University Farm, St. Paul, Minn.

Date ..... 19.....

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1914

The University of Minnesota

DEPARTMENT OF AGRICULTURE

SHORT COURSE IN TRACTION ENGINEERING

May 5 to June 5, 1914

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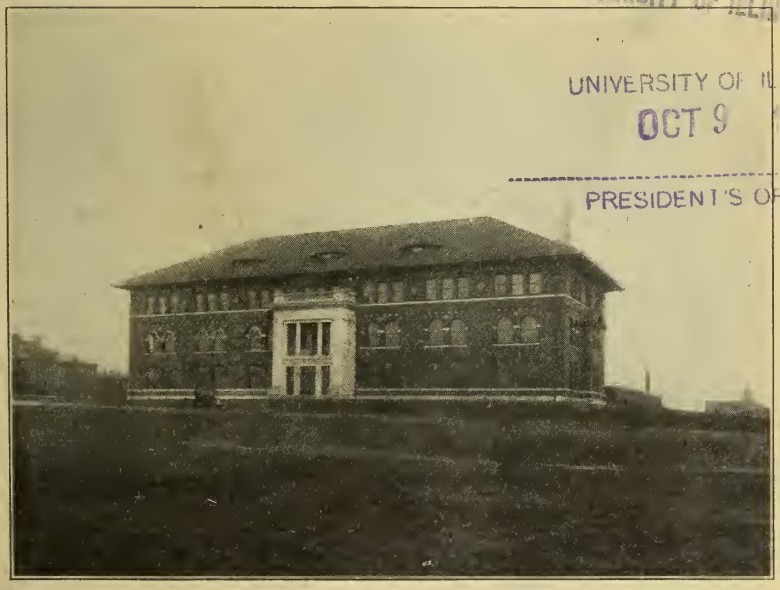

The Agricultural Engineering Building, University Farm

BULLETIN OF THE UNIVERSITY OF MINNESOTA
GENERAL SERIES NO. 7. JANUARY 1914

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THE SHORT COURSE IN TRACTION ENGINEERING

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The course is complete in itself, covering five weeks of study and practice. The mornings are devoted to lectures and classroom work, and the afternoons to actual practice under the supervision of the instructors of the School.

Such a course offers a great opportunity to the young man interested in mechanics, who has had some practical experience in the handling of engines, enabling him to acquire in a short time valuable training in the theory and practice of traction work.

LOCATION AND EQUIPMENT

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Located as it is between the two great cities of the Northwest, the students find every facility at hand to enable them to become proficient engineers.

EXPENSE OF COURSE

The tuition for the entire course is fifteen dollars, payable as a registration fee at the time of entrance. This covers instruction in all departments, traction, stationary, and gas engines. No deduction is made if the student elects but a part of the course, or fails to complete work from any cause whatever.

Each student is required to furnish work-clothes, overalls, gloves, and note books, and be prepared for the expense of carfare on trips of inspection to factories and other points of interest.

BOARD AND ROOM

Good board and room will be furnished on the campus for $17.50 for the term. The rooms have all necessary furniture and equipment. This arrangement will keep all the students together, and will allow more time for the practice work in all departments.

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A knowledge of Algebra and Physics is helpful but not necessary.

The work is made so simple and plain that those with this limited education required for admission can pursue the course with profit.

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TIME OF SESSION

The Short Course in Traction Engineering opens Tuesday, May 5, and continues for five weeks, closing Friday, June 5, 1914. Those desiring to take the course should register and secure boarding places Monday, May 4, as work begins promptly Tuesday morning.

COURSE OF STUDY

PHYSICS

Elementary physics is studied sufficiently to enable the students to understand the work given on boilers and engines as the following outline will show:

Matter, properties of matter, molecules, atoms, solid bodies, liquid bodies, gaseous bodies, vapor, temperature, absolute temperature, absolute zero, position of zero point on various thermometers, heat, unit of heat, work, horse power, pressure,

air pressure, gauge pressure, absolute pressure, circulation of air, vacuum, steam, dry steam, expansion of steam and gases, condensation of steam, sensible heat, latent heat, total heat, boiling point, effect of vacuum or pressure on boiling point, combustion of fuels, ignition temperature, products of combustion, combustion of carbon, combustion of nitrogen, heat of combustion, temperature of combustion.

STEAM BOILERS

Classification.—Based on location of fire and water, movability, construction, size.

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Fire Box Boilers.—Types, construction, size, advantages, disadvantages.

Water Tube Boilers.—Construction, types, size, setting and supporting, advantages, disadvantages.

Boiler Calculations.—How to calculate, safe working pressure, heating surface, grate surface, horse power.

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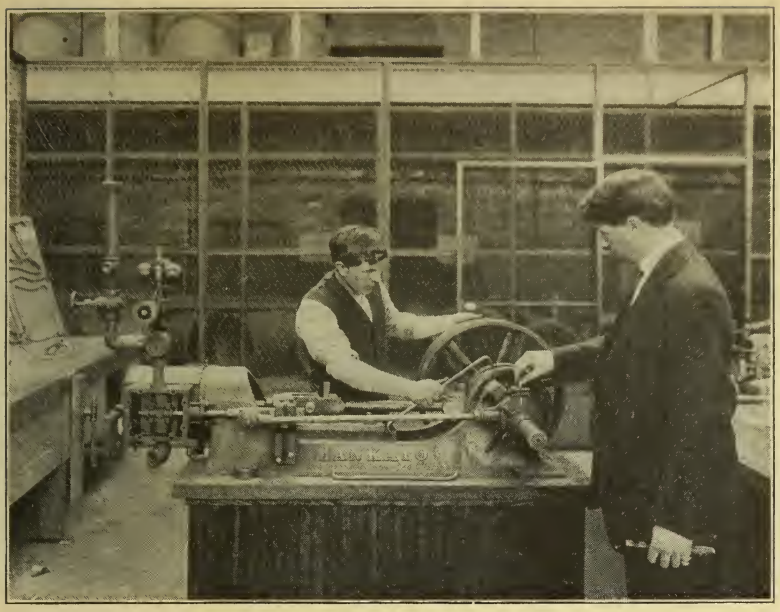

Setting the Valves

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Mechanism of the Gasoline Engine.—Piston, automatic and mechanical valves, cam-timing, two and four-cycle.

Gas Fuels.—Gasoline, kerosene, distillate, alcohol, storage.

Governors.—Hit or miss, throttling, volume.

Carburetors.—Types, pressure and gravity feeds.

Systems of Ignition.—Raw flame, hot tube, electric, dry cells, wet cells, storage batteries, dynamos, magnetos, high and low tension, connections, circuits, grounds, jump spark, make and break, spark-plugs, spark-coils, vibrators, timing of ignition.

Cooling.—Water, air, oil, anti-freezing solutions.
Lubricants.—Lubrication systems, choice of.
Multiple Cylinder.—Balance, order of firing.
Gasoline Traction.—Clutches, transmission, chain and gear drives.

BLACKSMITHING

The competent engineer should know how to handle iron at the forge. He should be able to weld when the necessity arises, and to temper his tools skillfully. To the students of this course a series of practical exercises will be offered covering the elements of iron and steel forging, tool-making and tempering. The aim will be to make the course as useful as possible to threshermen and engineers.

BELT-LACING

Demonstration lectures are given on the speed of pulleys, belting, and belt-lacing. Students are required to figure speed of pulleys and make samples of the belt-lacing in common use.

Practice in Rope-Splicing

BABBITTING

Lectures will be given on babbitt and babbitting. Each student will be required to do actual work in babbitting boxes.

PIPE-FITTING

Demonstration lectures are given on pipe-fitting, valves, etc. Students are required to cut and thread pipes, and to do some work in pipe-fitting.

ROPE-SPLICING

Every thresherman and engineer should know how to splice a rope and to tie all the useful knots known to the sailor. A series of lessons in this art will be given, covering all the common knots and splices.

SOLDERING

Demonstration lectures are given on metals, soldering materials and tools, and their use in soldering. Students are required to solder samples of various metals, etc.

TUBE-SETTING

Instruction in tube-setting is given and students are required to put in and remove tubes.

SPECIAL FEATURES

The regular school session will be held every day in the week, from 8:15 to 4:30; but Saturday afternoon will be devoted to visiting places of interest in and about the Twin Cities, under the direction of the instructors in the School.

Some of these places will be:

The Minnesota State Capitol, and its power-plant for lighting and heating.

The State Prison at Stillwater, and the manufacturing plants in connection with it.

The factories of the Northwest Thresher Company, the Gas Traction Company, and the Minneapolis Steel and Machinery Company.

The power plant of the Twin City Rapid Transit Company.

Pillsbury A Mill, the largest flour mill in the world.

The factory of the Minneapolis Threshing Machine Company, at Hopkins, where the processes in the manufacture of boilers, engines, and separators may be observed.

LICENSE

A number of states require any man who runs an engine to obtain a license, based on an examination held by an inspector. The State of Minnesota has such a law:

"Any person who shall operate any steam boiler or steam machinery of any kind, without first obtaining a license from an inspector, shall be deemed guilty of a misdemeanor, and fined not less than twenty-five dollars nor more than fifty dollars."

Pupils who take the course in this School, and receive the diploma after examination, may receive an engineer's license.

Engineers shall be divided into four classes, namely: Chief Engineers, First-Class Engineers, Second-Class Engineers, and Special Engineers.

Chief Engineers must have had at least five years of actual experience, and must be qualified to take charge of all classes of steam boilers and steam machinery.

First-Class Engineers must have had at least three years of experience, and must show that they are qualified to take charge of all classes of steam boilers and steam machinery not exceeding 300 horse-power.

Second-Class Engineers must have had at least one year of actual experience, and be licensed to operate boilers and steam machinery not to exceed 100 horse-power.

Special Engineers, if found competent on examination, are licensed to operate steam boilers and steam machinery not to exceed 30 horse-power.

Licenses will be issued by the State Boiler Inspector on payment of the legal fee of $1.

The licenses issued in this State will be accepted by most of the states as evidence of qualification to operate steam boilers and steam engines.

OTHER COURSES

THE SCHOOL OF AGRICULTURE

The School of Agriculture was organized to fit young men and women for successful farm life, and to give its students the necessary preparation for useful citizenship.

The course requires three winters of six months each for completion, and is coeducational. Much of the work is taken in common by both the young men and young women. Some of the subjects, such as blacksmithing, carpentry, field work, and handling grain and machinery, are taken by the young men; while the young women pursue cooking, sewing, laundering, and household art. The methods of instruction tend to educate students toward the farm instead of away from it, and to develop in them a love for farm life by showing them its possibilities.

DAIRY SCHOOL

The Dairy School opens before the middle of November and continues four weeks.

This course is designed to furnish persons who are actually engaged in the manufacture of butter and cheese, in creameries and cheese factories, an opportunity to become more skilled in their work, and also to study the many problems which have a direct bearing upon the dairy industry. Recognizing the fact that

The Forge Room, Where Blacksmithing Is Taught

such persons can not be away from business for a long period, the term has been so arranged that the time of each student is fully occupied by lectures and actual work in the creamery training-room every hour of every working day of the term.

JUNIOR SHORT COURSE

A one-week short course for boys and girls is held annually at the University Farm, St. Paul, opening the last Monday in March. The mornings are devoted to class study, the afternoons to excursions to points of interests in the Twin Cities. The cost to the student is three dollars for a week of pleasure and profit. Write for detailed information to the Extension Division, University Farm, St. Paul.

SHORT COURSE FOR FARMERS

The Short Course for Farmers is held for four weeks, starting late in January. It is designed to interest those of mature years who are actively engaged in farm work, and are ambitious

Soldering and Tinning

to become familiar with the most recent agricultural thought and practice. The selection of topics is very carefully made to cover the essentials of agriculture in as complete and thorough a manner as possible. The work is given in lecture form, including such subjects as stock and grain judging, horticulture, study of soils and fertilizers, and other matters of vital interest to the farmer, and demonstrated by laboratory work as far as possible.

SHORT COURSE FOR TEACHERS

The Summer Short Course for teachers, principals, and superintendents is established to meet the demand for agricultural instruction by educators who wish to teach the elements of agriculture, or who wish to be able to supervise the teaching of the subject intelligently in the public schools. It is intended to be especially helpful to teachers who desire to be more efficient in teaching the elements of agriculture in rural schools, or in small village schools having an attendance largely from the country.

The session opens about the middle of June and continues six weeks.

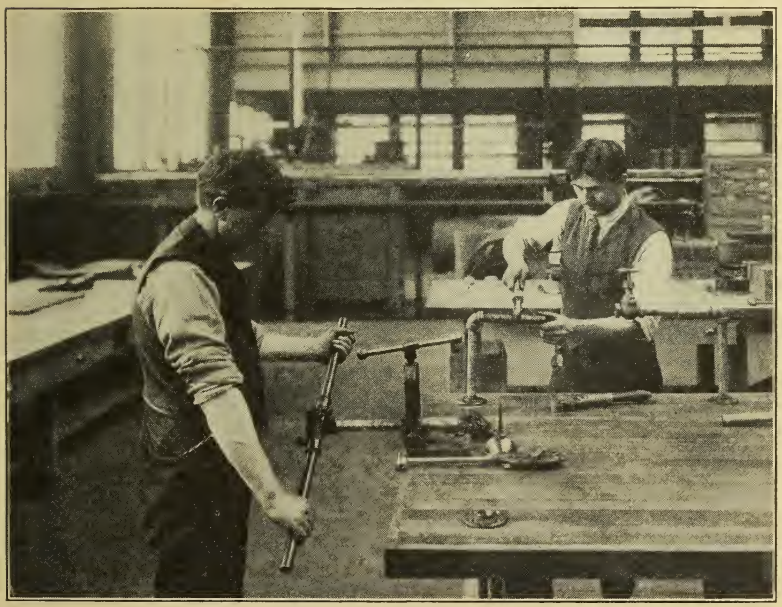
COLLEGE OF AGRICULTURE

The College of Agriculture provides a four-year course parallel with other colleges of the University. It opens in September and closes in June.

The course in Agriculture is designed to give the student a broad education in the sciences and arts relating to agriculture, and to fit him for the work of the agricultural specialist.

INQUIRIES

Anyone desiring further information in regard to these courses should apply to J. M. Drew, Registrar, University Farm, St. Paul, Minn.



A Laboratory Exercise in Pipe-Fitting

The University of Minnesota

SCHOOL OF TRACTION ENGINEERING

UNIVERSITY FARM, ST. PAUL

APPLICATION BLANK

Age..... Occupation..... yrs.

Nationality..... Residence in State..... yrs.

Education - Country School..... yrs.

City School..... yrs.

Special School..... yrs.

Experience - Steam Engines..... seasons

Sizes and makes.....

.....

.....

Gasoline Engines..... yrs.

Sizes and makes.....

.....

.....

Do you own an engine { Steam..... / Gasoline..... } Size.....

Engineer's License..... Class. ..... yrs.

Do you prefer Gasoline or Steam Engine instruction?

.....

Name.....

P. O. .....

Fill in above blank and send to

J. L. Mowry, University Farm, St. Paul, Minn.

Date..... 19.....

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1915

The University of Minnesota

DEPARTMENT OF AGRICULTURE

SHORT COURSE IN TRACTION ENGINEERING

May 4 to June 4, 1915

UNIVERSITY OF ILLINOIS
PRESIDENT'S OF

THE AGRICULTURAL ENGINEERING BUILDING, UNIVERSITY FARM

UNIVERSITY OF ILLINOIS LIBRARY

BULLETIN OF THE UNIVERSITY OF MINNESOTA
GENERAL SERIES NO. 24.] JANUARY 1915

Entered at the Post-Office
in Minneapolis as second-class matter
Minneapolis, Minn.

THE UNIVERSITY OF MINNESOTA

THE BOARD OF REGETS

The Hon. Fred B. Snyder, Minneapolis, President of the Board - 1916
George Edgar Vincent, Minneapolis - - - - - - - Ex-Officio
The President of the University
The Hon. Winfield S. Hammond, St. James - - - - Ex-Officio
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The Hon. Milton M. Williams, Little Falls - - - - - 1919
The Hon. John G. Williams, Duluth - - - - - - - - 1920
The Hon. George H. Partridge, Minneapolis - - - - - - 1920
The Hon. A. E. Rice, Willmar - - - - - - - - - - 1921
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DIVISION OF AGRICULTURAL ENGINEERING

FACULTY

George Edgar Vincent, Ph.D., LL.D. - - - - - - - President
Albert F. Woods, M.A., D.Agr. - - - - - - - - - - - Dean
John T. Stewart, C.E. - - - - Professor and Chief of Division
J. L. Mowry -
In charge Short Course in Traction Engineering; Gasoline Engines
E. C. Crane, M.E. - - - - - - - - - - - - Steam Engines
H. B. White, B.S. - - - - - - - - - - - - - Field Practice
A. D. Johnston - - - - - - - - - - - - - - Blacksmithing
L. R. Whitson, E.M. - - - - - - - - - - - - - - Physics
E. B. Cleworth - - - - - - - - - - - - - - Laboratory
G. F. Krogh - - - - - - - - - - - - - - Field Assistant

ENGINEER'S LICENSE

EXTRACT FROM RIVISED LAWS OF MINNESOTA, CHAPTER 31

No person shall be trusted with the operation of any steam boiler or steam machinery who has not received a license so to act, which license shall be renewed biennially. Every person who shall violate any provision of this section shall be guilty of a misdemeanor, and punished by a fine of not less than ten dollars nor more than fifty dollars.

1. A chief engineer shall be at least twenty-one years of age, be of such habits and have had such experience as to justify the belief that he is competent to take charge of all classes of steam boilers and steam machinery, and before receiving a license he shall take and subscribe an oath that he has had at least five years' actual experience in operating such boilers and machinery.

2. A first-class engineer shall be at least twenty-one years of age, be of such habits and have had such experience as to justify the belief that he is competent to take charge of all classes of steam boilers and steam machinery of not more than three hundred horse power. Before receiving a license, he shall take and subscribe an oath that he has had at least three years' actual experience in operating such boilers and machinery.

3. A second-class engineer shall be at least twenty-one years of age, be of such habits and have had such experience as to justify the belief that he is competent to take charge of all classes of steam boilers and steam machinery of not more than one hundred horse-power. Before receiving a license he shall take and subscribe an oath that he has had at least one year of actual experience in operating such boilers and machinery.

4. A special engineer, upon examination, shall be sufficiently acquainted with the duties of an engineer as to justify the belief that he can be safely intrusted with steam boilers and steam machinery of not more than thirty horse-power.

Neglect to secure inspection.—Every owner, lessee, or other person having charge of steam boilers or any boat propelled in whole or in part by steam, not subject to inspection under the laws of the United States, shall cause the same to be inspected at least once each year by the boiler inspector; and every such owner, lessee, or person in charge who shall raise steam or operate such boilers and machinery without such inspection shall be guilty of a misdemeanor.

Exemptions.—The provisions of this chapter shall not apply to railroad locomotives or locomotive engineers.

Note.—Those who take this course and receive Diploma after examination may take an Engineer's License.

Licenses will be issued by the State Boiler Inspector. The fee is $1.00.

Licenses issued in this State will be accepted by most of the States as evidence of qualification to operate steam boilers and engines.

THE SHORT COURSE IN TRACTION ENGINEERING

The growing use of traction engines in general farm work has made it advisable to offer a special course in the use of power machinery as one of the "short courses" in the Department of Agriculture of the University of Minnesota.

The course is complete in itself, covering five weeks of study and practice. The mornings are devoted to lectures and classroom work, and the afternoons to actual practice under the supervision of the instructors of the School.

Such a course offers a great opportunity to the young man interested in mechanics, who has had some practical experience in the handling of engines, enabling him to acquire in a short time valuable training in the theory and practice of traction work.

LOCATION AND EQUIPMENT

The short course in traction engineering is held at University Farm, St. Paul, midway between St. Paul and Minneapolis, a ten-minute walk from the car line. To reach the Farm, take the Como-Harriet or Como-Hopkins car from either city and get off at Carter Avenue.

Located as it is between the two great cities of the Northwest, the students find every facility at hand to enable them to become proficient engineers.

EXPENSE OF COURSE

The tuition for the entire course is fifteen dollars, payable as a registration fee at the time of entrance. This covers instruction in all departments, traction, stationary, and gas engines. No deduction is made if the student elects but a part of the course, or fails to complete work from any cause whatever.

Each student is required to furnish work-clothes, overalls, gloves, and note books, and be prepared for the expense of carfare on trips of inspection to factories and other points of interest.

BOARD AND ROOM

Good board and room will be furnished on the campus for $17.50 for the term. The rooms have all necessary furniture and equipment. This arrangement will keep all the students together, and will allow more time for the practice work in all departments.

REQUIREMENTS FOR ADMISSION

Any person of good moral character who can read, write, add, multiply, subtract, and divide, and who has had one season's experience with plowing or threshing outfits, or its equivalent in other lines, may be admitted to this School.

A knowledge of Algebra and Physics is helpful but not necessary.

The work is made so simple and plain that those with this limited education required for admission can pursue the course with profit.

Application for admission must be made by letter to J. L. Mowry, University Farm, St. Paul, Minnesota, using the blank at the back of this Bulletin.

TIME OF SESSION

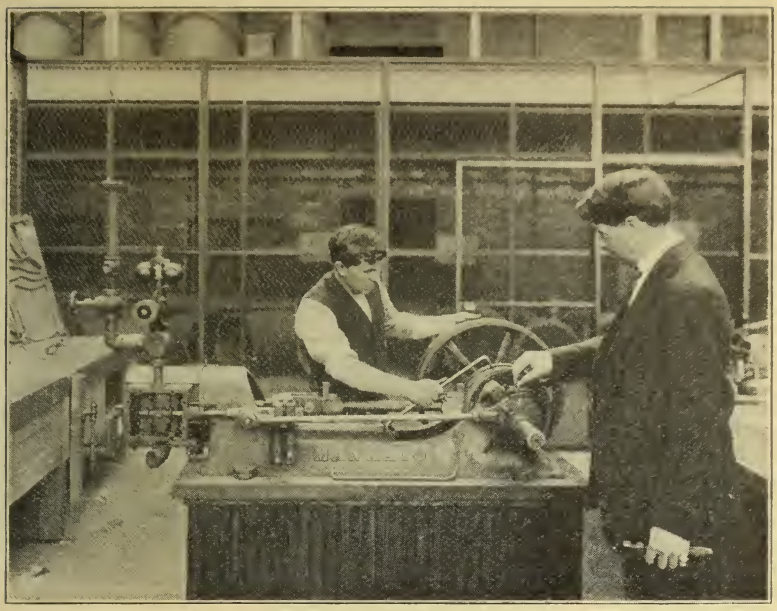
The Short Course in Traction Engineering opens Tuesday, May 4, and continues for five weeks, closing Friday, June 4, 1915. Those desiring to take the course should register and secure boarding places Monday, May 3, as work begins promptly Tuesday morning.

COURSE OF STUDY

PHYSICS

Elementary physics is studied sufficiently to enable the students to understand the work given on boilers and engines as the following outline will show:

Matter, properties of matter, molecules, atoms, solid bodies, liquid bodies, gaseous bodies, vapor, temperature, absolute temperature, absolute zero, position of zero point on various thermometers, heat, unit of heat, work, horse power, pressure, air pressure, gauge pressure, absolute pressure, circulation of air, vacuum, steam, dry steam, expansion of steam and gases,



Setting the Valves

condensation of steam, sensible heat, latent heat, total heat, boiling point, effect of vacuum or pressure on boiling point, combustion of fuels, ignition temperature, products of combustion, combustion of carbon, combustion of nitrogen, heat of combustion, temperature of combustion.

STEAM BOILERS

Classification.—Based on location of fire and water, movability, construction, size.

Horizontal Return Tubular Boiler.—Construction, size, setting and supporting, advantages, disadvantages.

Fire Box Boilers.—Types, construction, size, advantages, disadvantages.

Water Tube Boilers.—Construction, types, size, setting and supporting, advantages, disadvantages.

Boiler Calculations.—How to calculate, safe working pressure, heating surface, grate surface, horse power.

Boiler Fittings and Accessories.—Safety valves, gauge cocks glass gauge, water column, steam gauge, fusible plug, injectors, whistle, valves, blow-off pipe, feed pipe, blower, manholes, hand-holes, washout plugs, steam domes, steam drums, mud drum, super-heaters, feed water feeders, steam traps, steam separators, condensers, reducing valves.

Operation of Boilers.—Cleaning, boiler troubles, repairing, firing, boiler testing and inspection, laws regarding operation and licenses.

PUMPS

Classification.—Lift pumps, single acting, double acting, duplex, cross-head, belted or geared.

Construction.—Types of valves, number of valves, inside packed, outside packed, types of steam ends.

Pump Calculations—Height to which they will draw water; amount of water pumped; size of pistons and plungers; steam pressure required.

Operation.—Speed, troubles, repairing, setting steam valves.

STEAM ENGINES

Classification.—Reciprocating, rotary, oscillating, condensing, non-condensing, simple slide valve, piston valve, Corliss valve gear, compound, triple expansion.

Construction and Use of.—Bed, cylinder, piston, slide valve, eccentric, connecting rod, crank, etc.

Valve Setting.—Dead center, outside lap, inside lap, lead, point of cut-off, position of eccentric, angle of advance, setting valves with reverse gears.

Lubricators and Oil Pumps.—Purpose, types, construction, operation, troubles, adjustment, care.

Governors.—Purpose, types, construction, operation, troubles, adjusting, care.

Engine Calculations.—Use of steam indicator, mean effective pressure, reading indicator cards, horse power, tractive force.

Operation.—Starting, stopping, adjustment of parts, care. Special attention is given to traction engines.

GASOLINE ENGINES

Within the past few years, engines using the explosive power of gas as the means of securing mechanical motion have come into very extensive use. Whereas, ten or fifteen years ago such engines were very few in number and very uncertain in results, at the present time they probably outnumber engines of all other kinds, and in point of efficiency they are an undisputed success. Work in the construction and operation of gasoline and other engines of this class will be given throughout the term.

Mechanism of the Gasoline Engine.—Piston, automatic and mechanical valves, cam-timing, two- and four-cycle.

Gas Fuels.—Gasoline, kerosene, distillate, alcohol, storage.

Governors.—Hit or miss, throttling, volume.

Carburetors.—Types, pressure and gravity feeds.

Systems of Ignition.—Raw flame, hot tube, electric, dry cells, wet cells, storage batteries, dynamos, magnetos, high and low tension, connections, circuits, grounds, jump spark, make and break, spark-plugs, spark-coils, vibrators, timing of ignition.

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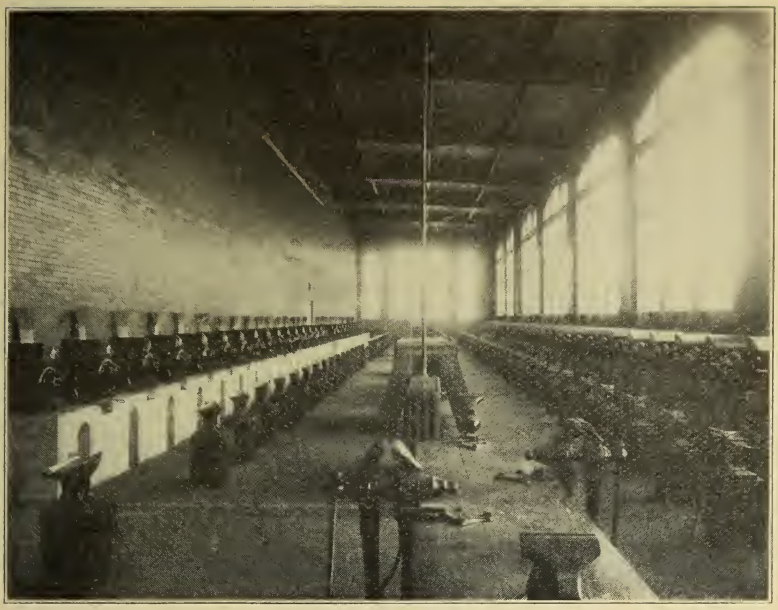

The Forge Room where Blacksmithing is Taught

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The factories of the Gas Traction Company, and the Minneapolis Steel and Machinery Company.

The power plant of the Twin City Rapid Transit Company.

The factory of the Minneapolis Threshing Machine Company, at Hopkins, where the processes in the manufacture of boilers, engines, and separators may be observed.

Soldering and Tinning

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The School of Agriculture was organized to fit young men and women for successful farm life, and to give its students the necessary preparation for useful citizenship.

The course requires three winters of six months each for completion, and is coeducational. Much of the work is taken in common by both the young men and young women. Some of the subjects, such as blacksmithing, carpentry, field work, and handling grain and machinery, are taken by the young men; while the young women pursue cooking, sewing, laundering, and household art. The requirement for admission is completion of the eighth grade of the common-school course. Adults who have not finished the eighth grade may be admitted if they show ability to do the work of the school.

DAIRY SCHOOL

A four weeks' course in creamery butter-making and factory cheese-making is offered each fall, beginning about the 10th of November. The forenoons are spent in classrooms where lectures and talks are given by practical creamery men on all phases of the dairy business. The only requirement for the course is six months' experience in a creamery or cheese factory. Following the regular dairy school a one-week course in commercial ice-cream-making is offered.

BOYS' AND GIRLS' WEEK

One week during the last of March or the first of April is Boys' and Girls' Week at University Farm, St. Paul. The mornings are devoted to a study of some of the most interesting and important phases of agriculture. In the afternoons excursions are taken to points of interest in and about the Twin Cities. The cost to each student after arriving is about $3.00. Special efforts are made by all at University Farm to crowd this week full of pleasures and profit to the boys and girls. There is no educational requirement for admission. For detailed information, write Extension Division, University Farm, St. Paul.

FARMERS' AND HOME-MAKERS' WEEK

The week immediately following New Year's is devoted to the Farmers and Home-Makers of the State in their annual conferences at the College of Agriculture, University Farm, St. Paul. Regular class work occupies a portion of each day, at which the most vital and recent agricultural knowledge is presented by the faculty of the College of Agriculture and others Conferences are held from day to day of those having a special interest in some particular problem of agriculture. Many of the State Agricultural Associations hold their meetings during this week. An interesting and instructive evening program is furnished for each day. Men of national agricultural reputation from Minnesota and other states participate in the programs. Lectures and demonstrations in farm crops, farm management, soils, dairy and animal husbandry, horticulture, farm engineering, poultry, bees, veterinary science, and home economics are given daily. There is no educational requirement for admission.

SUMMER SESSION AND STATE TEACHERS' TRAINING SCHOOL

During six weeks of the summer, beginning immediately after the close of the regular University session in June, two short courses are offered at University Farm of interest to teachers and others. The regular summer session of the College of Agriculture offers regular college courses in agriculture and home economics, including courses in agronomy, farm management, soils, dairy and animal husbandry, agricultural chemistry, agricultural education, botany and plant pathology, horticulture, entomology, and home economics. These courses give regular college credit upon their completion and the fulfilling of entrance requirements. At the same time and place the State Teachers' Training School offers courses in all of the teachers' certificate subjects and also special courses in agriculture, home economics, manual training, music, drawing, school management, and physical education, and similar subjects for teachers.

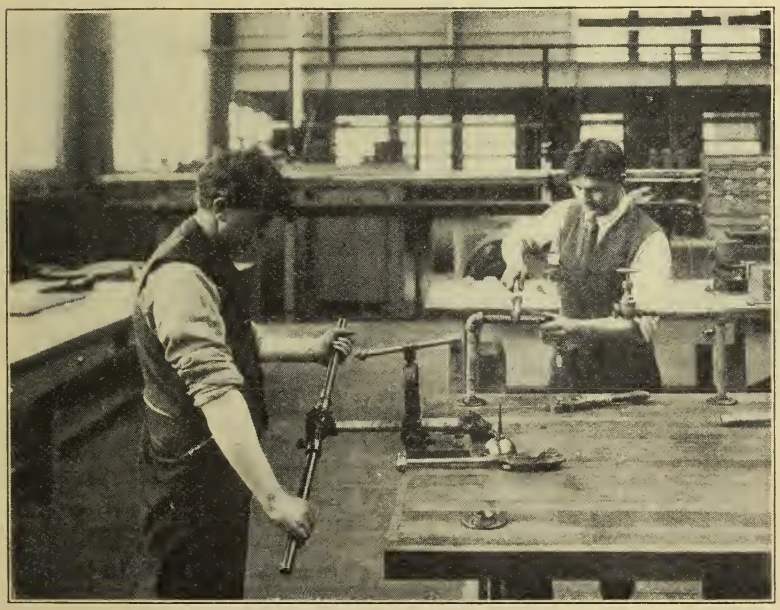
COLLEGE OF AGRICULTURE

The College of Agriculture provides a four-year course in agriculture for men and in home economics for women, parallel with the courses of other colleges of the University. The college opens in September and closes in June. Preparation equivalent to graduation from an accredited high school is required for admission. The course in agriculture is designed to give the student a broad education in the sciences and arts relating to agriculture and to fit him for the work of the agricultural specialist.

Three courses are offered in Home Economics, each leading to the degree of Bachelor of Science. The general course is designed to prepare women for the responsibilities of homemaking and of citizenship. The teachers' course includes the courses required in the general course and, in addition, special preparation for teaching. The third course is designed to prepare teachers for a special division of the field of Home Economics, that of textiles and clothing.

INQUIRIES

Anyone desiring further information in regard to these courses should apply to J. M. Drew, Registrar, University Farm, St. Paul, Minn.



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UNIVERSITY FARM, ST. PAUL

APPLICATION BLANK

Age..... Occupation.....yrs.

Nationality..... Residence in State.....yrs.

Education - Country School.....yrs.

City School.....yrs.

Special School.....yrs.

Experience - Steam Engines.....Seasons

Sizes and makes.....

.....

.....

Gasoline Engines.....yrs.

Sizes and makes.....

.....

.....

Do you own an engine { Steam..... / Gasoline..... } Size.....

Engineer's License.....Class. .....yrs.

Do you prefer Gasoline or Steam Engine instruction?

.....

Name.....

P. O.....

Fill in above blank and send to

J. L. Mowry, University Farm, St. Paul, Minn.

Date.....19.....

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1916

Bulletin of The University of Minnesota

DEPARTMENT OF AGRICULTURE

SHORT COURSE IN TRACTION ENGINEERING

May 2 to June 2, 1916

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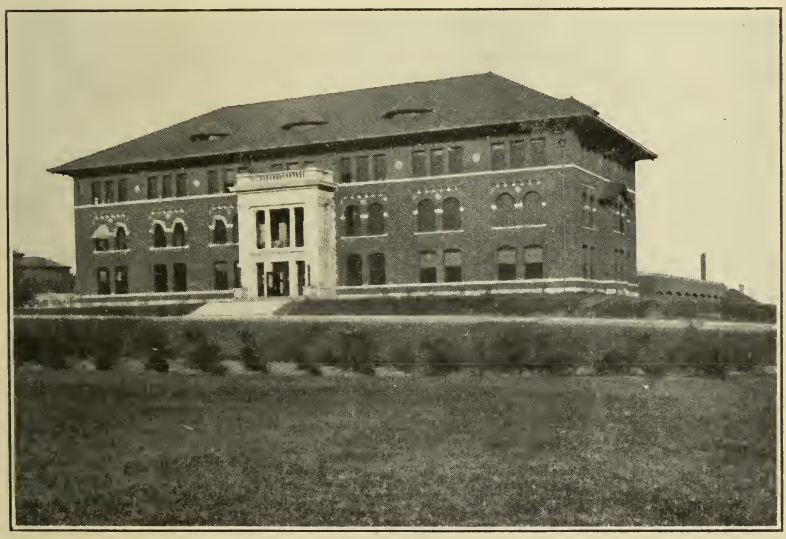

THE AGRICULTURAL ENGINEERING BUILDING, UNIVERSITY FARM

GENERAL SERIES NO. 33. SEPTEMBER 1915

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UNIVERSITY OF ILLINOIS
PRESIDENT'S OFFICE
URBANA, CHAMPAIGN

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George Edgar Vincent, Ph.D., LL.D. - - - - - - - President
Albert F. Woods, M.A., D.Agr. - - - - - - - - - - Dean
John T. Stewart, C.E. - - - - Professor and Chief of Division
J. L. Mowry - - - - - - - - - - - - -
In charge Short Courses in Traction Engineering; Gasoline Engines
E. C. Crane, M.E. - - - - - - - - - - - - Steam Engines
H. B. White, B.S. - - - - - - - - - - - - Field Practice
A. D. Johnston - - - - - - - - - - - - - Blacksmithing
L. R. Whitson, E.M. - - - - - - - - - - - - Physics
E. B. Cleworth - - - - - - - - - - - - Laboratory
G. F. Krogh - - - - - - - - - - - - Field Assistant

SHORT COURSE COMMITTEE

A. V. Storm, Chairman
W. G. Brierley, Secretary
D. D. Mayne
Andrew Boss
Josephine T. Berry
John T. Stewart
Robert M. Washburn
W. P. Kirkwood

ENGINEER'S LICENSE

EXTRACTS FROM GENERAL STATUTES OF MINNESOTA, CHAPTER 31

Duties of owners and engineers.—No person shall be trusted with the operation of any steam boiler or steam machinery who has not received a license so to act, which license shall be renewed biennially. Every person who shall violate any provision of this section shall be guilty of a misdemeanor, and punished by a fine of not less than ten dollars nor more than fifty dollars.

Classifications and qualifications of engineers.—A chief engineer shall be at least twenty-one years of age, be of such habits and have had such experience as to justify the belief that he is competent to take charge of all classes of steam boilers and steam machinery, and before receiving a license he shall take and subscribe an oath that he has had at least five years' actual experience in operating such boilers and machinery.

A first-class engineer shall be at least twenty-one years of age, be of such habits and have had such experience as to justify the belief that he is competent to take charge of all classes of steam boilers and steam machinery of not more than three hundred horse power. Before receiving a license, he shall take and subscribe an oath that he has had at least three years' actual experience in operating such boilers and machinery.

A second-class engineer shall be at least twenty-one years of age, be of such habits and have had such experience as to justify the belief that he is competent to take charge of all classes of steam boilers and steam machinery of not more than one hundred horse power. Before receiving a license he shall take and subscribe an oath that he has had at least one year of actual experience in operating such boilers and machinery.

A special engineer, upon examination, shall be sufficiently acquainted with the duties of an engineer as to justify the belief that he can be safely intrusted with steam boilers and steam machinery of not more than thirty horse power.

Neglect to secure inspection.—Every owner, lessee, or other person having charge of steam boilers or any boat propelled in whole or in part by steam, not subject to inspection under the laws of the United States, shall cause the same to be inspected at least once each year by the boiler inspector; and every such owner, lessee, or person in charge who shall raise steam or operate such boilers and machinery without such inspection shall be guilty of a misdemeanor.

Exemptions.—The provisions of this chapter shall not apply to railroad locomotives or locomotive engineers.

Those who take this course and receive Diploma after examination may take an Engineer's License.

Licenses will be issued by the State Boiler Inspector. The fee is $1.00.

Licenses issued in this State will be accepted by most of the states as evidence of qualification to operate steam boilers and engines.

Agricultural Engineering Building and Exterior of Shops

THE SHORT COURSE IN TRACTION ENGINEERING

The growing use of traction engines in general farm work has made it advisable to offer a special course in the use of power machinery as one of the "short courses" in the Department of Agriculture of the University of Minnesota.

The course is complete in itself, covering five weeks of study and practice. The mornings are devoted to lectures and classroom work, and the afternoons to actual practice under the supervision of the instructors of the School.

Such a course offers a great opportunity to the young man interested in mechanics, who has had some practical experience in the handling of engines, enabling him to acquire in a short time valuable training in the theory and practice of traction work.

LOCATION AND EQUIPMENT

The Short Course in Traction Engineering is held at University Farm, St. Paul, midway between St. Paul and Minneapolis, a ten-minute walk from the car line. To reach the Farm, take the Como-Harriet or Como-Hopkins car from either city and get off at Carter Avenue.

Located as it is between the two great cities of the Northwest, the students find every facility at hand to enable them to become proficient engineers.

EXPENSE OF COURSE

The tuition for the entire course is fifteen dollars, payable as a registration fee at the time of entrance. This covers instruction in all departments, traction, stationary, and gas engines. No deduction is made if the student elects but a part of the course, or fails to complete work from any cause whatever.

Each student is required to furnish work-clothes, overalls, gloves, and note books, and be prepared for the expense of carfare on trips of inspection to factories and other points of interest.

BOARD AND ROOM

Good board and room will be furnished on the campus for $17.50 for the term. The rooms have all necessary furniture and equipment. This arrangement will keep all the students together, and will allow more time for the practice work in all departments.

REQUIREMENTS FOR ADMISSION

Any person of good moral character who can read, write, add, multiply, subtract, and divide, and who has had one season's experience with plowing or threshing outfits, or its equivalent in other lines, may be admitted to this School.

A knowledge of algebra and physics is helpful but not necessary.

The work is made so simple and plain that those with this limited education required for admission can pursue the course with profit.

Application for admission must be made by letter to J. L. Mowry, University Farm, St. Paul, Minnesota, using the blank at the back of this Bulletin.

TIME OF SESSION

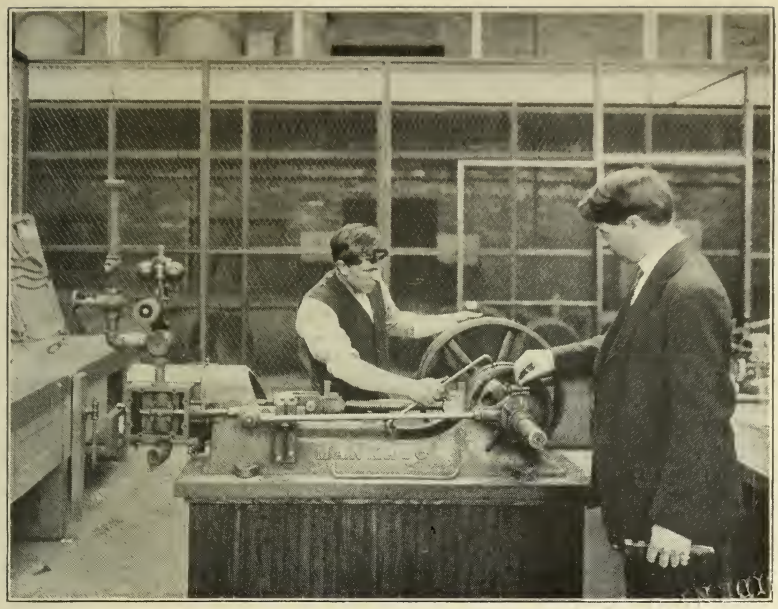
The Short Course in Traction Engineering opens Tuesday, May 2, and continues for five weeks, closing Friday, June 2, 916. Those desiring to take the course should register and secure boarding places Monday, May 1, as work begins promptly Tuesday morning.

COURSE OF STUDY

PHYSICS

Elementary physics is studied sufficiently to enable the students to understand the work given on boilers and engines as the following outline will show:

Matter, properties of matter, molecules, atoms, solid bodies, liquid bodies, gaseous bodies, vapor, temperature, absolute temperature, absolute zero, position of zero point on various thermometers, heat, unit of heat, work, horse power, pressure, air pressure, gauge pressure, absolute pressure, circulation of air, vacuum, steam, dry steam, expansion of steam and gases,



Setting the Valves

condensation of steam, sensible heat, latent heat, total heat, boiling point, effect of vacuum or pressure on boiling point, combustion of fuels, ignition temperature, products of combustion, combustion of carbon, combustion of nitrogen, heat of combustion, temperature of combustion.

STEAM BOILERS

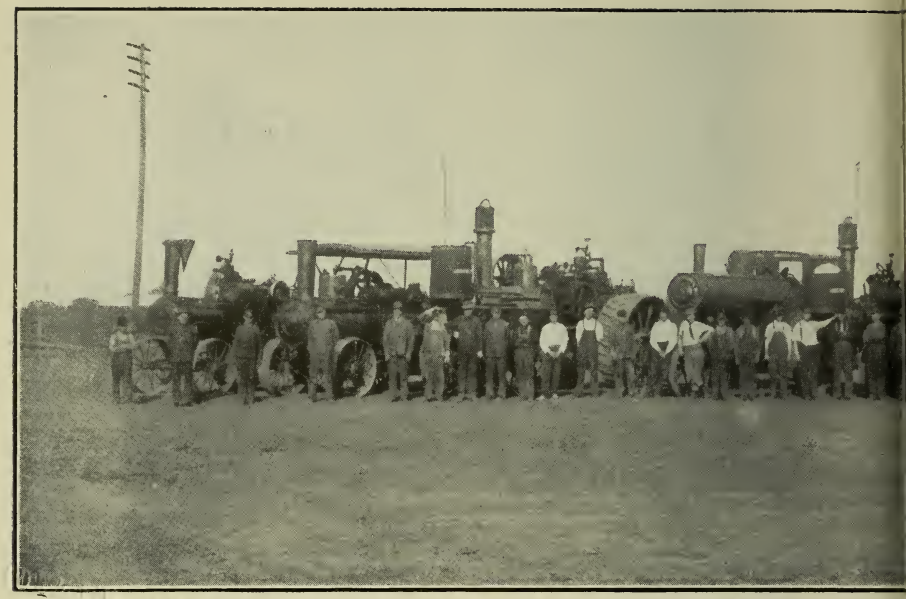
Classification.—Based on location of fire and water, movability, construction, size.

Horizontal Return Tubular Boiler.—Construction, size, setting and supporting, advantages, disadvantages.

Fire Box Boilers.—Types, construction, size, advantages, disadvantages.

Water Tube Boilers.—Construction, types, size, setting and supporting, advantages, disadvantages.

Boiler Calculations.—How to calculate safe working pressure, heating surface, grate surface, horse power.



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Boiler Fittings and Accessories.—Safety valves, gauge cocks, glass gauge, water column, steam gauge, fusible plug, injectors, whistle, valves, blow-off pipe, feed pipe, blower, manholes, hand-holes, washout plugs, steam domes, steam drums, mud drum, super-heaters, feed water feeders, steam traps, steam separators, condensers, reducing valves.

Operation of Boilers.—Cleaning, boiler troubles, repairing, firing, boiler testing and inspection, laws regarding operation and licenses.

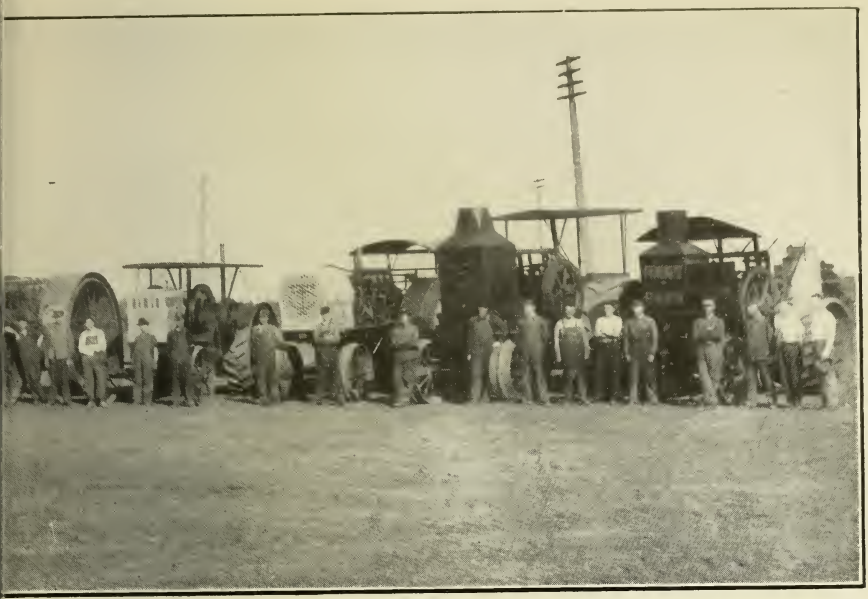
PUMPS

Classification.—Lift pumps, single acting, double acting, duplex, cross-head, belted or geared.

Construction.—Types of valves, number of valves, inside packed, outside packed, types of steam ends.

Pump Calculations.—Height to which they will draw water; amount of water pumped; size of pistons and plungers; steam pressure required.

Operation.—Speed, troubles, repairing, setting steam valves.



STEAM ENGINES

Classification.—Reciprocating, rotary, oscillating, condensing, non-condensing, simple slide valve, piston valve, Corliss valve gear, compound, triple expansion.

Construction and Use of.—Bed, cylinder, piston, slide valve, eccentric, connecting rod, crank, etc.

Valve Setting.—Dead center, outside lap, inside lap, lead, point of cut-off, position of eccentric, angle of advance, setting valves with reverse gears.

Lubricators and Oil Pumps.—Purpose, types, construction, operation, troubles, adjustment, care.

Governors.—Purpose, types, construction, operation, troubles, adjusting, care.

Engine Calculations.—Use of steam indicator, mean effective pressure, reading indicator cards, horse power, tractive force.

Operation.—Starting, stopping, adjustment of parts, care. Special attention is given to traction engines.

GASOLINE ENGINES

Within the past few years, engines using the explosive power of gas as the means of securing mechanical motion have come into very extensive use. Whereas, ten or fifteen years ago such engines were very few in number and very uncertain in results, at the present time they probably outnumber engines of all other kinds, and in point of efficiency they are an undisputed success. Work in the construction and operation of gasoline and other engines of this class will be given throughout the term.

Mechanism of the Gasoline Engine.—Piston, automatic and mechanical valves, cam-timing, two- and four-cycle.

Gas Fuels.—Gasoline, kerosene, distillate, alcohol, storage.

Governors.—Hit or miss, throttling, volume.

Carburetors.—Types, pressure and gravity feeds.

Systems of Ignition.—Raw flame, hot tube, electric, dry cells, wet cells, storage batteries, dynamos, magnetos, high and low tension, connections, circuits, grounds, jump spark, make and break, spark-plugs, spark-coils, vibrators, timing of ignition.

Cooling.—Water, air, oil, anti-freezing solutions.

Lubricants.—Lubrication systems, choice of.

Multiple Cylinder.—Balance, order of firing.

Gasoline Traction.—Clutches, transmission, chain and gear drives.

BLACKSMITHING

The competent engineer should know how to handle iron at the forge. He should be able to weld when the necessity arises and to temper his tools skilfully. To the students of this course a series of practical exercises will be offered covering the elements of iron and steel forging, tool-making and tempering. The aim will be to make the course as useful as possible to threshermen and engineers.

BELT-LACING

Demonstration lectures are given on the speed of pulleys, belting, and belt-lacing. Students are required to figure speed of pulleys and make samples of the belt-lacing in common use.

The Forge Room where Blacksmithing is Taught

BABBITTING

Lectures will be given on babbit and babbitting. Each student will be required to do actual work in babbitting boxes.

PIPE-FITTING

Demonstration lectures are given on pipe-fitting, valves, etc. Students are required to cut and thread pipes, and to do some work in pipe-fitting.

ROPE-SPLICING

Every thresherman and engineer should know how to splice a rope and to tie all the useful knots known to the sailor. A series of lessons in this art will be given, covering all the common knots and splices.

SOLDERING

Demonstration lectures are given on metals, soldering materials and tools, and their use in soldering. Students are required to solder samples of various metals, etc.

Practice in Rope-Splicing

TUBE-SETTING

Instruction in tube-setting is given and students are required to put in and remove tubes.

SPECIAL FEATURES

The regular school session will be held every day in the week, from 8:15 to 4:30; but Saturday afternoon will be devoted to visiting places of interest in and about the Twin Cities, under the direction of the instructors in the School.

Some of these places will be:

The State Prison at Stillwater, and the manufacturing plants in connection with it.

The factories of the Gas Traction Company, and the Minneapolis Steel and Machinery Company.

The factory of the Minneapolis Threshing Machine Company, at Hopkins, where the processes in the manufacture of boilers, engines, and separators may be observed.

Soldering and Tinning

OTHER COURSES

THE SCHOOL OF AGRICULTURE

The School of Agriculture was organized to fit young men and women for successful farm life, and to give its students the necessary preparation for useful citizenship.

The course requires three winters of six months each for completion, and is coeducational. Much of the work is taken in common by both the young men and young women. Some of the subjects, such as blacksmithing, carpentry, field work, and handling grain and machinery, are taken by the young men; while the young women pursue cooking, sewing, laundering, and household art. The requirement for admission is completion of the eighth grade of the common-school course. Adults who have not finished the eighth grade may be admitted if they show ability to do the work of the school.

DAIRY SCHOOL

A four-weeks' course in creamery butter-making and factory cheese-making is offered each fall, beginning about November 10. The forenoons are spent in classrooms where lectures and talks are given by practical creamery men on all phases of the dairy business. The only requirement for the course is six months' experience in a creamery or cheese factory. Following the regular dairy school a one-week course in commercial ice-cream-making is offered.

BOYS' AND GIRLS' WEEK

One week during the last of March or the first of April is Boys' and Girls' Week at University Farm, St. Paul. The mornings are devoted to a study of some of the most interesting and important phases of agriculture. In the afternoons excursions are taken to points of interest in and about the Twin Cities. The cost to each student after arriving is about $3.00. Special efforts are made by all at University Farm to crowd this week full of pleasure and profit to the boys and girls. There is no educational requirement for admission. For detailed information, write Extension Division, University Farm, St. Paul.

FARMERS' AND HOME-MAKERS' WEEK

The week immediately following New Year's is devoted to the farmers and home-makers of the state in their annual conferences at the College of Agriculture, University Farm, St. Paul. Regular class work occupies a portion of each day, at which the most vital and recent agricultural knowledge is presented by the faculty of the College of Agriculture and others. Conferences are held from day to day of those having a special interest in some particular problem of agriculture. Many of the state agricultural associations hold their meetings during this week. An interesting and instructive evening program is furnished for each day. Men of national agricultural reputation from Minnesota and other states participate in the programs. Lectures and demonstrations in farm crops, farm management, soils, dairy and animal husbandry, horticulture, farm engineering, poultry, bees, veterinary science, and home economics are given daily. There is no educational requirement for admission.

SUMMER SESSION AND STATE TEACHERS' TRAINING SCHOOL

During six weeks of the summer, beginning immediately after the close of the regular university session in June, two short courses are offered at University Farm of interest to teachers and others. The regular summer session of the College of Agriculture offers regular college courses in agriculture and home econmics, including among other things courses in agronomy, farm management, soils, dairy and animal husbandry, agricultural chemistry, agricultural education, botany and plant pathol-

ogy, horticulture, entomology, and home economics. These courses give regular college credit upon their completion and the fulfilling of entrance requirements. At the same time and place the State Teachers' Training School offers courses in all of the teachers' certificate subjects and also special courses in agriculture, home economics, manual training, music, drawing, school management, and physical education, and similar subjects for teachers.

COLLEGE OF AGRICULTURE

The College of Agriculture provides a four-year course in agriculture for men and in home economics for women, parallel with the courses of other colleges of the University. The college opens in September and closes in June. Preparation equivalent to graduation from an accredited high school is required for admission. The course in agriculture is designed to give the student a broad education in the sciences and arts relating to agriculture and to fit him for the work of the agricultural specialist.

Three courses are offered in home economics, each leading to the degree of Bachelor of Science. The general course is designed to prepare women for the responsibilities of homemaking and of citizenship. The teachers' course includes the courses required in the general course and, in addition, special preparation for teaching. The third course is designed to prepare teachers for a special division of the field of home economics, that of textiles and clothing.

RURAL-LIFE CONFERENCE

A rural-life conference is held late in July. Its aim is to bring together leaders in country-life activities—pastors, Sunday-school workers, officers of young people's societies, teachers, leaders of farmers' clubs and contest clubs, social and welfare workers—to discuss problems of special interest in rural communities. No fees are charged, and the accommodations of the campus are at the disposal of delegates at very slight cost. Two such conferences have been held, with great profit to those who attended.

INQUIRIES

Anyone desiring further information in regard to these courses should apply to J. M. Drew, Registrar, University Farm, St. Paul, Minn.

The University of Minnesota

SCHOOL OF TRACTION ENGINEERING

UNIVERSITY FARM, ST. PAUL

APPLICATION BLANK

Age..... Occupation.....yrs.

Nationality..... Residence in State.....yrs.

Education—Country School.....yrs.

City School.....yrs.

Special School.....yrs.

Experience—Steam Engines.....Seasons

Sizes and makes.....

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Gasoline Engines.....yrs.

Sizes and makes.....

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Do you own an engine { Steam..... / Gasoline..... } Size.....

Engineer's License..... Class.....yrs.

Do you prefer Gasoline or Steam Engine instruction?

Name.....

P. O.....

Fill in above blank and send to

J. L. Mowry, University Farm, St. Paul, Minn.

Date....., 19.....

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